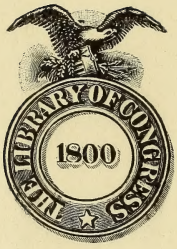
THE GAIT OF THE AMERICAN TROTTER AND PACER

RUDOLF JORDAN, JR.



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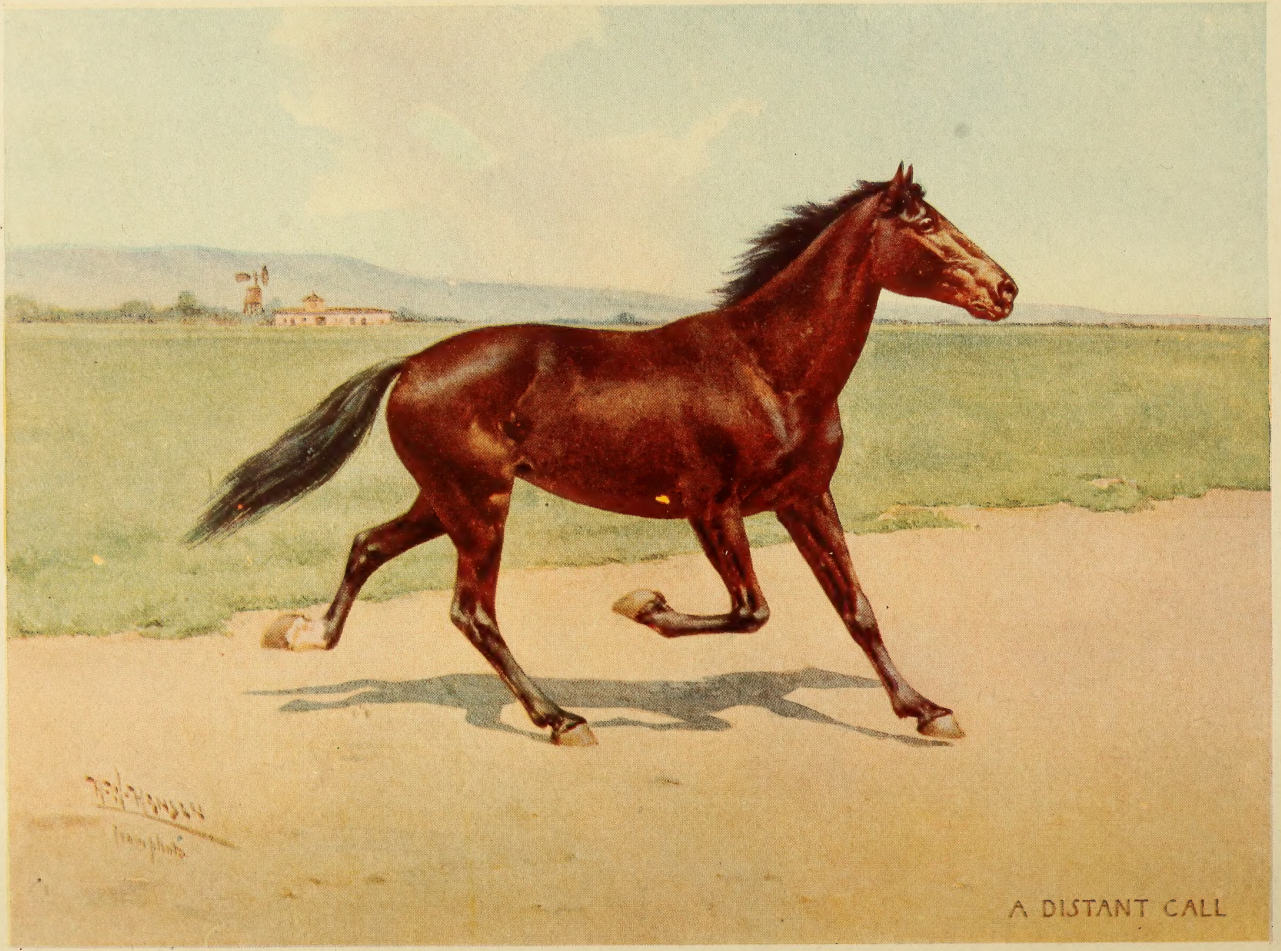

A DISTANT CALL

THE GAIT

OF THE AMERICAN

TROTTER AND PACER

AN ANALYSIS OF THEIR GAIT BY A NEW METHOD

AND

AN INVESTIGATION OF THE GENERAL PRINCIPLES CONCERNING THE PROPER BALANCING OF

MOTION ACTION AND EXTENSION

BY

RUDOLF JORDAN, JR.

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THIS BOOK IS DEDICATED TO THE CAUSE OF THE HUMANE TREATMENT AND RATIONAL CARE OF THE HORSE, WITHOUT WHOSE DRUDGERY AND CONSTANT TOIL THE PROGRESS OF THE WORLD WOULD HAVE BEEN MATERIALLY RETARDED, AND THE COMFORTS AND PLEASURES OF OUR DAILY LIFE WOULD BE FAR LESS IN DEGREE AND EXTENT

PREFACE

Every owner and every trainer of a trotter or pacer, in fact, every one to whom the horse in general is a source of revenue or of pleasure, should make himself familiar with the simple principles of the animal's locomotion, and with the rational system of shoeing, as presented and advocated by the late David Roberge, in his book "The Foot of the Horse." Though given to the public over ten years ago, it is doubtful whether its real worth has been generally appreciated and estimated.

The late David Roberge of New York seems to have been one of the few intelligent horseshoers who combine the science with the art of their trade. He came to the rescue of the suffering equine world with a logical and simple method. His connections with Robert Bonner gave him the advantage of the views of that great student of the horse's locomotion, to whose persuasion is due the publication of that book. Their experiences and deductions were identical and constitute the most rational views and data on this subject.

In a personal correspondence with the writer he regretted that ill health had prevented him from supplementing his work with another on the special subject of balancing the gait of the fast trotter and pacer, because he felt the need of just such a treatise. As it is he took up the cause of the horse in general, thereby appealing to every owner who wishes to use the horse to the best possible advantage. All the greater in consequence becomes the merit of his work.

The writer is grateful to him for valuable suggestions, and has for many years put into practice his system of shoeing. This effort to prove and to apply his teachings have led to a systematic analysis of gait by means of measurements and by averages and variations, so as to plot the peculiarities of each horse's mode of locomotion. The outcome is a sytsem which, though based on Roberge's investigations, is itself original in conception. It is offered in the hope that it will assist many owners and trainers of our fast trotters and pacers in solving the

intricate problem of balancing or adjusting the motion, extension and action of the horse at speed.

The laws of "pointing", or the horse's movement of the foot in the lines of least inconvenience or pain, as laid down by Roberge, form a very simple and rational foundation for paring the hoof and putting on the shoe. Much thought has already been given to this subject of balancing and gaiting, but as yet little has been done or shown by any methodical investigation.

Granting that much knowledge of gait may be gathered by sight, sound and sensation, in other words, by watching the action from all points of the compass and by listening to the fall of the feet, as well as by feeling the mouth while speeding, all proper balancing under such observation will nevertheless remain more or less guess-work. It will always be tedious experimenting for lack of definite data; and even when success crowns the countless efforts and there is a happy combination of adjustment, it is apt to be momentary and will give no rule for a repetition of the same conditions. Unless some more precise and exact method can be devised, there will be no record left behind, and we shall not possess any definite knowledge. Such guess-work and repeated haphazard trials, even when successful for a time, give no rational explanation of previous conditions or of the effect of any changes, or of the final results.

What is wanted is some plan or method by which any fault in the action or extension can be readily discovered and one's whole energy can be employed from the very start toward a possible correction of such deficiency.

Let us not gamble with Luck, cautions the Sage of Concord, but deal directly with Cause and Effect. Even then chances may be against us, but we at least deal with the subject in a logical and not in an irrational manner.

It is not claimed by the writer that *any* horse, or all of them, can be *made* to move squarely and fast by such a method, but merely that the faulty action can be more readily detected. It will be shown that there is at least a rational plan for the discovery, if not for the removal, of the cause of faulty or deficient action. *No cure-all is offered,* nor

is there a wish to belittle the judgment of intelligent horseshoers; for these there will be enough to do in spite of all knowledge of faulty action.

Far from overestimating my knowledge of shoeing, I beg to leave the importance of proper shoes for special needs to the intelligent men at the forge, who should understand the anatomy of the foot as well as they know how to turn and apply a sensible shoe. There is no patent on this method. Anybody with a little ability to figure and with a little accuracy and patience can work out the necessary data. Special note books for that purpose may be had from the author.

This book is the result of much time and labor, just as other duties would allow and opportunities offered themselves; but during the long years of his investigations, the writer was always guided by the principle that authority and tradition, though good as a basis, should not be looked upon as being free from grievous error. It is a human habit to follow tradition and routine as the safest and quickest way out of difficulties and to yield to the undefinable attraction or mystery of luck. An open-minded inquiry directed solely and without prejudice towards the establishment of facts led to the investigations here offered. As reasonable and plausible as the assertions of Roberge appeared to be, his theory of pointing lacked proof as regards animals in motion. These assertions were likewise subjected to continued tests by this method until they were shown to be either entirely true or partly true.

At bottom, however, of these very facts there is at all times the great beauty of animal motion in which every lover of the horse delights. To convey this to the mind, when the eye cannot actually see it, is the mission of the true artist. I have, therefore, given as the very first illustration, a copy of a picture of a three-year-old colt, bred and at one time owned by me, which was painted by our well-known artist, H. W. Hansen. His watercolors of horses in motion are everywhere recognized for their exquisite coloring and excellent outline and depth. The half-tone reproduction does not quite come up to the original in color effect, but the expression and attitude of the animal are worth noting.

Without the advice and assistance of others I would not now be

able to put these investigations before the public, and I therefore, take pleasure in acknowledging my gratitude to all who have aided me.

To my old friend, Dr. H. H. Claussen, I am indebted for his careful instruction regarding the anatomy and make-up of the horse; and to J. P. Patery, a skilful and intelligent horseshoer of Oakland, Cal., for much practical advice and for his very efficient services at all times. For the diligent and successful efforts in the training and driving of the horses under observation, I am also indebted to Howard L. Franklin, of Syracuse, N. Y., K. O'Grady and sons, of San Mateo, Cal., and to C. B. Bigelow, of Woodland, Cal.

Furthermore, I take occasion to acknowledge my obligation to I. B. Dalziel, T. W. Barstow, O. V. Greene, "The Horse Review," Ted Hansom, and Schreiber & Sons, and M. H. Reardon, for their courtesy extended regarding the use and reproduction of some excellent photographs; and I also wish to express my thanks to George W. Ellis for his painstaking efforts and for his advice in the matter of illustrations, and to Dwight L. Hackett—last but not least—for his suggestions in presenting this book to the public.

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THE GAIT

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TROTTER AND PACER

"The epochs of our life are not in the visible facts of our choice of a calling, our marriage, our acquisition of an office, and the like, but in a silent thought by the wayside as we walk; in a thought which revives our entire manner of life and says: 'Thus hast thou done, but it were better thus.'"

Ralph Waldo Emerson (*Spiritual Laws*).

CHAPTER I.

WANTED—A SQUARE GAIT.

One of the most puzzling and intricate problems for the trainer of the trotter or pacer to solve is proper balance. By "balance" is meant such exact adjustment of hitching and checking, weight of shoes, as well as length of toe and its angle with heel, that will bring about, with the least expenditure of energy on the part of the horse, the most regular and frictionless, the truest and freest action, and therefore the greatest speed which such a horse is capable of producing.

The great difficulty of controlling a horse's locomotion lies not only in the complexity of a living organism, but also more particularly in the shape and the articulation of the leg and the hoof. Where, however, the relations of the mental and physical qualities of the horse are not such as to suggest or establish the so-called trotting instinct, or the ability to stick to the trotting (or pacing) action, even man's best devices and efforts often fail. It may lie within the possibilities of the laws of heredity that by continual training of successive generations of the harness horse this instinct will become more of a fixed or typical characteristic. The ideal outcome of such hereditary influence would, therefore, seem to be a more ready response to the training for speed, and may bring about the disuse of all the cumbersome paraphernalia for the protection of the legs and of the cruel and unnatural check-line, so that a free action and a free head may become the general results of all combined efforts of the breeding and training of our harness horse.

Any sound and well bred trotter or pacer that has not been abused will stick to a square gait and will, true to his instinct, try to do his level best until constrained by some difficulty of movement. In most cases these are mechanical hindrances, such as ill-shaped feet, too

heavy or too light a shoe, or one of bad shape, or the general discomfort of the harness and of the hitching to cart or sulky.

Any forced methods, such as whipping, in order to "straighten him out" after irregular action or a break, can hardly come under the head of training and show lack of balance in the man behind the animal rather than in the horse.

The secret of the American trainer's success with the harness horse lies in his appeal to the animal's moral and mental qualities. Such a course makes the horse reliable and on it hinges more or less the result of a speed contest. To develop this confidence and courage in a horse proper balance is absolutely essential. A square gait alone will conserve muscle and strength, and will increase endurance. Besides, there is the spectator's point of view to be considered, because there is nothing as impressive as a horse that goes like a piece of machinery, and the public takes delight in the unswerving regularity and equalized energy of a square gait.

There are trainers who seem to favor an irregular gait on the score that it rests a horse and that it makes him "catch" his gait more readily after a "break" or run. Skipping behind or rolling in front may favor such a handy "catch" because no time is lost in squaring away again. It really amounts to a questionable means "to get there", but does not constitute an honest effort such as the spectator has a right to demand. The usefulness of the harness horse should not be lost sight of, and all training should be directed toward bringing out the best qualities and teaching the best manners. The sport of speed contests—known also under the questionable name, "the game"—should be "on the square," and it is therefore to the interest of the cause of the harness horse that he should be trained to a square gait only.

Every trainer knows what a square gait is. In the course of this discussion on gaits as given in this book it will be shown that a square gait means nothing more nor less than an even and equal extension backward and forward for all the four moving legs of the horse, with two pair of feet striking the ground at equal intervals of time and distance during a given trial.

Many faults of gait can be learned by studying the tracks of the horse's hoofs on the ground, and I urge trainers in general, and owners too, to direct their attention to these footprints. For, from the nature and position of these tracks, they can arrive at a remedy for a faulty gait much more quickly. It is not very hard work—considering the results—to rake off a piece of ground, which has been previously harrowed and is moist enough to show the tracks plainly. The record of the ground may serve to lead to a better record of the mile, and the impressions on the ground may help to effect better impressions on the grand stand. To give it meaning we must have two things, namely, a tape line and a white cord. The latter is stretched midway between the two sulky-wheel tracks and figures as a line of reference for the position of the feet; and the 100 ft. tape line serves in the measurements of all the successive footprints. The middle line is assumed as being the line of motion of the horse's center of gravity, around which all weight and motion is equally distributed. In a square gait, therefore, we should have the position of the feet on either side at equal distances from this line of reference. Any deviation would argue a certain deficiency or a bad habit of the gait. Such a wrong direction of motion may be due to some structural fault or to some temporary impediment caused by faulty shoeing. In either case a remedy may correct an irregular gait. Much can be learned merely by an inspection of the tracks thus referred to the middle line. Whether much figuring is done or not, some idea at least may be gained from the positions of the feet. Of course, the presumption here is that the trial so made did proceed in a straight, or nearly straight, line. The speed of a horse is most efficient in straight lines.

An irregular position of one or more feet can be readily detected and will indicate the possible remedy for a better direction or position of same. If not convenient, the figuring on these positions, as given later on in the fourth chapter, may be omitted and notes could be made merely from the inspection by eye.

As to the use of the tape line, there is need of a little more work. The simpler features of such measurements are given again in Chapter X. Suffice it to say here that the tape line should be applied until we

have either ten or twenty strides on record. It is not one individual stride that will show any deficiency, but it is rather the *averages* of the various distances between the tracks that can give us a truthful account of a certain manner of gait.

First, there is the *stride,* or the distance between the two contacts at the toe of one and the same foot. Then there is the distance between the two feet that move together. This should be the same for both sides in a square gait. Again, there is the distance between one fore foot and the opposite one, or between one hind and its opposite mate. In a square gait these also are alike or nearly so. Sometimes a horse has a habit to extend one foot ahead of the other, in which case the hind that moves with that fore will also extend ahead of its mate. The distances thus measured will give us, by means of averages, a more trustworthy account of the manner of propulsion than the eye can possibly detect.

The tape line used should be 100 ft. long and should be divided into 10 parts to the foot instead of 12 parts. This will facilitate figuring. A stride of 15 ft. and 3 inches, or 15¼ ft., will therefore appear as 15.25 ft. This enables us to add, subtract, multiply and divide as we do with dollars and cents, which avoids all the trouble incident to the figuring in inches. Of course, the tape line will have to be staked a number of times to include 20 strides. The measurements should be put down in a continuous form in a notebook and the figuring done later; or it may be done on the spot as the various feet are taken. The latter way, however, takes too long on the ground and is more difficult. In the trot the start is made from the toe of *near fore* foot, in the pace from the toe of the *near hind* foot. The toe is the beginning and end of each distance so marked. A little systematic arrangement of the continuous measurements will soon bring the matter clearly before one's mind. Reference is again made to the tenth chapter, where a general outline is given. The reader may prefer to find out for himself what is meant by such measurements and how they are obtained before he is willing or able to follow the discussions in the intervening chapters. I believe, however, that the subject is not so difficult for anyone who has at all applied himself to the study of

equine locomotion and balance. I would like to have the reader prove to himself, by his own trials, that I am not trying to set up any particular theory regarding the motion of the horse, but that definite data of this sort give the best foundation for practical results and that there is a practical value to the investigation here offered. Many a reader may, however, turn from the various demonstrations as being too intricate and go back to the chance of hitting upon a lucky combination of circumstances. He may possess intuition or the knack of doing things without knowing the reason why. Some men have that insight and strike the right thing. Sometimes the reward comes to him who waits—long enough. Most of us, however, are not gifted that way and for all of us it seems better and safer to hew and saw timber by lines and figures.

What I intend to show in the course of this investigation is that irregular extensions of the legs, which mainly cause a faulty gait and loss of speed, can be equalized again by means of a different adjustment of shoes, such as weight, length and angle of hoof, and the shape of the shoe. Such unequal extensions must, however, be established from *general averages* and not from a *few casual measurements*. We should, therefore, make a trial for such measurements of at least ten strides, if not twenty, which will show the defects even better. The *average* of any of such distances is the sum of those distances divided by the number of times such distances were taken or computed. Any one of these distances may vary considerably from any other, but the average must show any peculiarity of gait.

These requirements may offer some difficulties at first, but a little familiarity with the positions of the feet on the ground will soon make matters clear. Special note books, such as I have used, will be prepared and offered at a reasonable price to those who may want to take up this matter with horses of their own.

This book will show in various cases the effects of weight and shape of shoe, of toeweights, of the angle of foot and of the length of toe. The combinations possible between these factors are almost numberless, and trainers may succeed better than I have in making a proper combination on suggestions herein given. The general deductions

from this investigation may briefly, though incompletely, be summarized as follows:

Mere weight of shoe in front will increase action rather than extension, mere weight behind will increase extension rather than action. The shape of the shoe, of course, will in either case modify both action and extension. A high heel or a long toe will, again, modify the effects of both weight and shape of shoe, the high heel by itself causing a "pointing back" and the long toe by itself causing a "pointing forward." Again, a longer or higher foot—both at toe and heel—will act as a check in front to that foot and will be a lever for the greater extension of its opposite mate. Injury to the front leg by concussion is often due to such slightly longer foot. The greater the speed, the greater the effect of any small difference between the fore or the hind feet. Again, a longer foot behind increases extension and will put a strain on its opposite mate through the latter's forced backward extension. Skipping and running behind may have this difference for a cause, though unequal lengths of toes or angles of feet may also be at fault.

In the experiments I have tried to show that inequality of weight, angle or toe may at times become necessary to effect a square gait. Such remedies may be temporary or permanent, according to whether the irregular gait is due to an acquired habit or to some structural fault. Some consideration will also be given to the extensions of the legs around the turns of the track, as well as to the effects of uphill and downhill grades on the locomotion of the horse.

I have not had much of a choice of subjects. Some were good and others indifferent horses. Some horses, again, were not amenable to treatment for speed development, but nearly all of them could be made to acquire a square gait while at their greatest speed. The breeding of the horses given, wherever noted, should not be construed as a reflection on family faults, and is only meant to show that the subjects were trotting-bred. Each horse should be treated as an individual by this method, because each has faults in a different combination with the whole make-up of the horse.

To set forth the subject as clearly as possible it was necessary to

present many illustrations and diagrams. The reader may have some difficulty in understanding them, but a greater familiarity with the nature of the motion of the horse, according to the simple plan outlined above and in Chapter X, will soon enable him to overcome such apparent difficulties. Shoeing and balancing is a difficult subject at best and requires *TIME* as a *PRIME CONDITION* to bring about any satisfactory result at all. By means of this method and with a little perseverance the particular gait of each individual horse may be ascertained, and from such definite data it will not be so very difficult to follow a plan of shoeing that will make the subject stick to a *SQUARE GAIT*.

CHAPTER II.

THE TRACKS AND MOTION OF THE FEET.

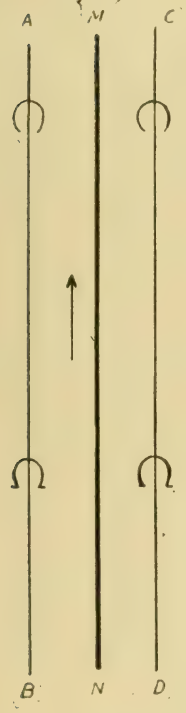
We have in the horse at motion five moving points, namely, the four feet, which strike the ground and thereby cause propulsion, and the center of gravity, around which his weight is equally distributed. This latter invisible point lies in a plane bisecting, or cutting into two equal halves, the horse at right angles with or vertical to the ground plane. We think of this center of gravity being somewhere in the forequarter of the horse about midway in the girth region.

No matter what the action of the legs may be, whether high or low, the motion of the horse is the most perfect and graceful when this center of gravity is freest from up and down or side to side movements. It is most pleasing to the eye and most effective in point of speed when this center of gravity keeps in a practically straight line, and the motion of the legs is most economical of force and hence beautiful, when, looked at vertically from behind or in front, they proceed in nearly straight lines, and when even the curves of their action, looked at from the side, are all four of nearly the same magnitude and of the least elevation. In other words, the ideal trot should proceed from straight movements and nearly equal elevations of the four feet. Therefore, when all force of motion is directed forward and shows the least deviation from straight lines we must of necessity have the best results in speed with the least expenditure of energy.

The lines of motion of the four feet must therefore be parallel to the line described by the center of gravity, and must, moreover, be at equal distances from it on each side. The vertical plane containing the center of gravity will meet or intersect the ground plane midway between the lines described by the feet. This center line I have called the *median line* and for practical purposes it can be located midway

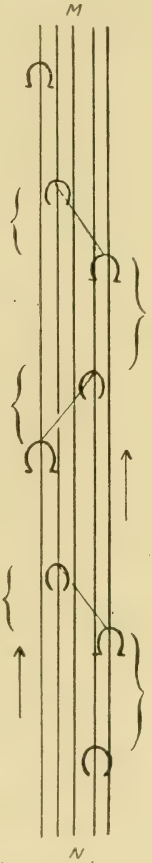
between the wheels of the vehicle drawn (see Fig. 1). We shall see later on that the distances on either side of line M N are not always alike and that, moreover, the four feet describe four lines instead of only two. Fig. 1 represents an illustration of the ideal *line trot.*

FIG. 1



A B = Lines of feet on near side
C D = Lines of feet on off side
M N = median line

FIG. 2.



○ = fore foot
Ω = hind foot
M N = median line

Furthermore, the actions of the legs, or rather their extension, must be like that of a pendulum swinging backward and forward to the same extent. This equal extension from an imaginary plumb line through the middle of leg insures the requisite regularity of gait,

rhythm of the fall of feet, and harmony between hind and front extremities. Any deviation from the above lines of action will be due either to a natural or to an acquired or accidental fault in the structure of the legs or feet. These deviations will enter largely into this investigation, because most horses have some structural faults to overcome in their effort at speed. The correction of such faults, wherever possible, constitutes largely what is called "balancing."

We come now to the consideration of the imprints or tracks left on the ground by the trotter at speed. Fig. 2 will show the relative position of fore and hind feet of a horse going at about a 2:30 gait. Roughly estimated, we have here a stride of 16 ft., with about 3 ft. between the diagonal or correlated feet which move together, and with about 5 ft. as the distance of hind over fore, or *overstep*. The

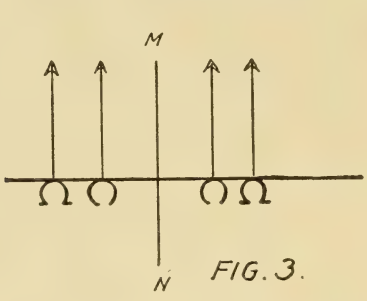


FIG. 3.

small brackets show the diagonal or correlated feet and the longer brackets the oversteps. Ordinarily this is the notation, or order of succession, of the four moving feet as they strike the ground. The distance between the feet is intentionally much exaggerated to show the lines of motion on each side. As a rule the distance between the fore, measured from the middle of frogs, is from 2 to 4 inches, and the distance between the hind probably averages from 4 to 7 inches. Now and then we strike a line trotter whose lines of motion of fore and of hind are nearly coincident. It is safe to say that in nearly all trotters the hind feet spread more than the fore. This is no doubt due to the greater mobility of the hind, as well as to the probability of their obtaining a better hold of ground by spreading somewhat. In no case of a fast trotter do we find an *extreme* outside position of hind as in Fig. 3. No doubt the larger spread of hind is also due to a pos-

sible interference of hind with fore at I in Fig. 4, A and B, and the endeavor to avoid such. In A we have a knee-hitter and in B a

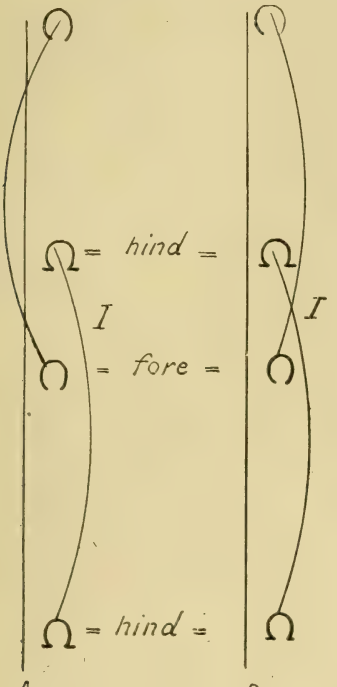


FIG. 4.

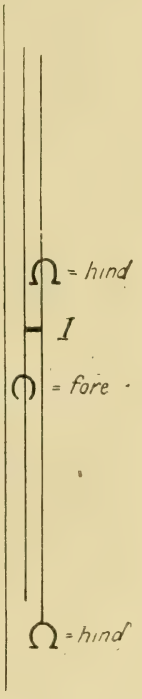


FIG 5

paddler. The curves of motion of hind are excessive in this instance merely to show the tendency to spread and the point of possible contact. In the approximate line trot we are likely to have the same slight

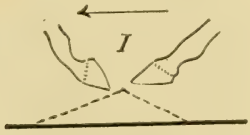


FIG. 6.

contact, as at I in Fig. 5, if the length of the animal does not counteract such contract, as in I in Fig. 6, where the hind cannot cross the path of the fore except after the fore has preceded it. Such an action

is more likely to be found in the line trot, which we must assume as being the ideal locomotion.

All our investigations of such motion, whose record is left on the ground, should be made on an even surface of such a nature as the tracks of this country present. The ground should be harrowed or raked by hand, leaving a surface of fine loose earth on top, just as a fast and safe track is generally kept.

We must base such investigations on this even surface so that unevenness of gait is not due to roughness of ground, but to the causes which we wish to ascertain. Ordinarily the greater the distance measured the better will be the results, but all the way from 10 to 20 strides will show the gait well enough. Horses at a fair speed and according to the nature of the gait will stride from 16 to 21 feet with each leg as they fly through the air from one imprint to the next. I have always taken 20 strides as my basis of calculations, because, firstly, the distance is long enough to show repetition of faults, or rather the variations from the average; and, secondly, because the simple decimal number is easy to divide with in the calculations. We shall, therefore, require a stretch of from 360 to 420 ft.

The second important requirement of such an investigation is an even rate of going when trotting over this stretch with the horse at speed. The line so taken should also be as straight as possible; but ordinarily both these requirements are fulfilled because of the nature of the trial, which is but a piece out of a quarter or half mile. We may safely assume that if the speed is not uniform or the line straight, this is due to the very causes we intend to investigate. Averages and variations tell a truthful tale just the same.

Let us imagine that all these preliminary conditions are established and we look at the tracks of the horse just driven over that piece of ground.

There will be the record on the ground as given in Fig. 2. We know that in the trot two diagonally opposite feet move at the same time. Let us call them the *correlated* feet, because of their similar extension and action at the same time. In Figs. 7, 8 and 9 we have these correlated feet at rest, in a slow walk and in a trot. The fall of

these feet must occur at the same time; that is, one fore and one hind should touch the ground at the same time. This is eminently so in the true trot and pace. Nor should there be any accent on the fall of one pair more than on the other. In order to bring about this regularity the distance of one fore from the other and of one hind from the other, should be the same; that is, the extension of all four should be equal. And if this is so, then the two distances between the correlated feet should be the same. In fact, it will be found that the fundamental principle of the square trot is the equal distance between these

FIG. 7.

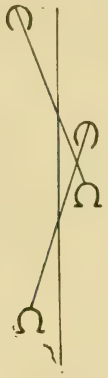


FIG. 8

FIG. 9

diagonally opposite feet. The same principle holds good with the distance between the lateral feet, or feet on the two sides of the pacer. These also strike the ground at the same time and must be equally separated for even action and extension.

In Figs. 10, 11 and 12 we shall take a brief look at the positions of the pacer when at rest, in a slow walk and at speed. What is true of the trotter's locomotion is also true of that of the pacer, with some slight modifications. A *line pace* is not generally spoken of as often as a *line trot,* but what holds good of lost motion in curves in one gait is also true in the other, and the danger point of interference is similar. As in the trot the hind foot is likely to interfere with the

fore foot, but on the opposite side as it passes it in the air at about I

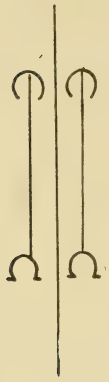


FIG. 10

FIG. 12.

FIG. 11

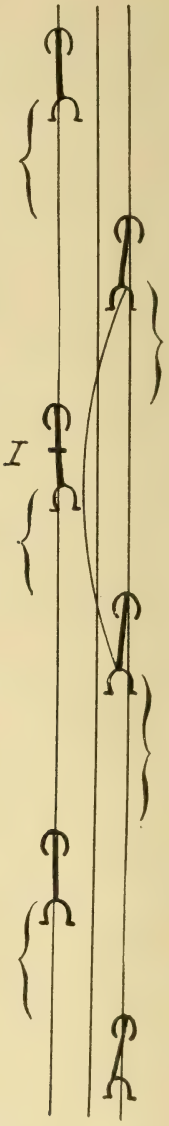


FIG. 12.A

in Fig. 12A. This constitutes "cross-firing" in the pacer. As in the trot the "overstep" was the overlap of one pair of correlated feet over the

other pair, so also in the pace there is a distance of opposite pair of feet as indicated by the brackets in Fig. 12A.

And again, as in the trot, these distances between the pairs of lateral feet, or the extension on one side and on the other, should be equal; but we shall see later on that in either gait the extension on one side may exceed that on the other a little, because of the habit of horses to relieve themselves under great exertion by placing one foot ahead of the other. We shall also find that generally in the pace the fore feet are apt to spread farther apart than the hind and the tendency of the lines of motion is given in Fig. 13. The *line pace,* however, constitutes the standard to judge by.

We can, therefore, assert that the two distances between the correlated feet on both sides should be the same in both the trot and the

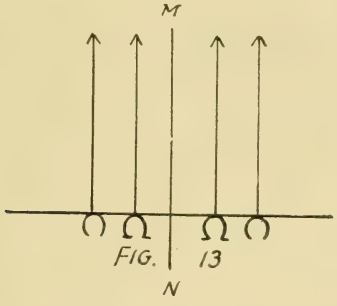


FIG. 13

pace. We also have seen that there is a possible interference of hind with fore as the pairs of correlated feet pass each other in midair, and that, inasmuch as any curves in the locomotion of either gait tend to loss of time and energy, there is a *line trot* as well as a *line pace* as the most economic form of propulsion as far as time and energy is concerned. Judged by these standards of gait, any locomotion deviating largely from them is faulty because it produces a certain amount of "lost motion," or motion to the sides, with all the dangers of interference.

Such must be the standards, but where faulty action accordingly exists there may be some compensations that offset these faults. On the whole, nature has a wonderful way of making amends for deficiencies in her creations of the animal as well as the human family.

She counterbalances a weak structure by a correspondingly larger development elsewhere. In other words, we may find a compensation or an offset in hind gait for whatever may be out of the ordinary with the fore action, and vice versa.

A phenomenon like Lou Dillon can give free play and action to her hind legs by a peculiar habit of crossing over with fore. At first this seems excessive and impossible, but her wonderful speed is that of a phenomenon. Later on we shall analyze her peculiar gait. Other great trotters may have similar habits of motion; but we cannot judge the good ordinary trotter by a phenomenon, and it is best to take the locomotion of the majority of trotters as a standard form in establishing the faults and shortcomings of gait. Speed is born with some horses; it is like genius—everything else adjusts itself to that gift. That wonderful capacity to trot extremely fast with a frictionless gait evolves from the brain of the horse from early youth, and somehow the motion seems perfect, even though it should prove to be only a matter of compensations in the movements of legs. By compensation is meant that balance of development which counteracts weakness here by strength there in the make-up of the horse and in his motion. We find, for instance, a horse with very high action in front and low action behind, and yet he trots fast and true. The eye is not pleased, our sense of symmetry is sadly jarred and our task of balancing a trotter of that kind is truly great at times; and yet we learn to accommodate shoeing to that mode of action and will find it nearly impossible to equalize the action and to make it conform to that *standard* or ideal motion, where there is the least difference between the elevation of fore and hind and where the speed is attained without undue exertion. The test of measuring the extensions and computing the averages and variations—in other words, the analysis of such an apparently unequal action—will reveal the fact that the symmetry of extension is good and that the feet land squarely on the ground.

This brings us to the ordinary way of judging the trotter's action by the eye, or by the side view while in motion.

The human eye has always claimed great accuracy of observation concerning things in motion, but photography has shown how unre-

liable it is in its verdict. We are now quite familiar with the positions of feet and motion of legs as the camera has fixed them in their progression while the horse is moving. At first it was unbelievable; so set is the human mind on traditions.

In the next chapter, therefore, we shall consider the action as seen from the side.

CHAPTER III.

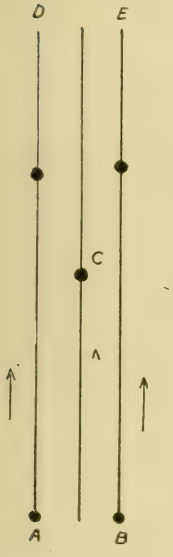
ATTITUDE AND MOTION OF THE LEGS.

Many years ago Dr. J. B. D. Stillman published a book on "The Horse in Motion", under the patronage of the late Gov. Leland Stanford, the maker and owner of the once famous Palo Alto Farm. Here a very skilful photographer by the name of E. J. Muybridge took a series of photographs of animals in motion and succeeded in proving as unnatural all previously conceived ideas regarding the various attitudes of animals in motion. The photographs were a wonderful revelation, not only to the men engaged with horses, but also to the world at large and particularly to students and masters of art. The services that Muybridge rendered to the cause of the horse and of art can never be overestimated, for they lie at the very foundation of a correct understanding of animal motion. It was in these experiments that the strides of the moving horse was first measured and roughly stated for each horse, and this fact, together with David Roberge's sound principles of "pointing," first suggested the present analysis of the trot and pace. It seemed as if the record left on the ground by the tracks of each foot might be a sort of photograph of his mode of propulsion. Puzzling as the idea appeared to the writer some ten years ago, it gained in importance and interest as case after case was subjected to such an investigation. Before considering this method we have still to look into the motion of the legs, such as photography was able to present.

We have in the horse five moving points, namely, his four feet and the center of gravity situated in his body in a plane passing lengthwise through the middle of the body, this plane being at right angles with or perpendicular to the ground plane or surface. This center of gravity acts as a pivot of locomotion around which weight is equally

distributed and upheld. The motion of the horse is most perfect and graceful when this center of gravity is freest from up and down or side to side movements. It is most pleasing to the eye and most effective in point of speed when this center of gravity keeps in a practical straight line; and the motion of the legs is most beautiful and most economical of force when, looked at vertically from behind or in front, it proceeds in nearly straight lines and when

FIG. 14



C = centre of gravity
A D & B E = lines of motion of feet.

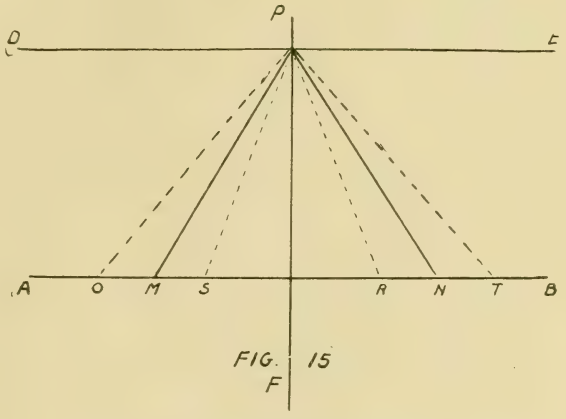


FIG. 15

D E, plane of motion of fixed end of pendulum P F.
A B, ground plane.
P M, P N, equal forward and backward extension or swing.
P, point in shoulder or hip at which legs may be presumed to be pivoted like a pendulum.
Dotted lines, variations from equal extensions.

even the curve of its elevation, looked at from the side, is not excessive, but presents a natural height for the speed shown.

Therefore, when all the force of motion is directed forward and shows the least deviation from a straight line horizontally and no excessive curves vertically, we must of necessity have the very best result in speed with the least expenditure of energy. The lines of motion of the four legs must therefore be parallel to the line described by this central point in the body, called the center of gravity (see Fig. 14), and must, moreover, be equi-distant from it on each side; and, further-

more, must the action of the legs be like that of a pendulum swinging backward as far as forward, and thus bring about the regularity and rhythm of hoof-beats and the harmony of extensions (see Figs. 15 and 16.)

To illustrate the above principles, which ought to constitute the perfect gait of the trotter and the pacer, let us look at Fig. 16. Here is the profile view of a horse at rest in an ideal attitude, namely, where the legs stand perpendicularly under the body of the subject.

Vertical lines from the heels H′ and H of both fore and hind (Fig. 16) will constitute the pendulums of legs at rest, having their

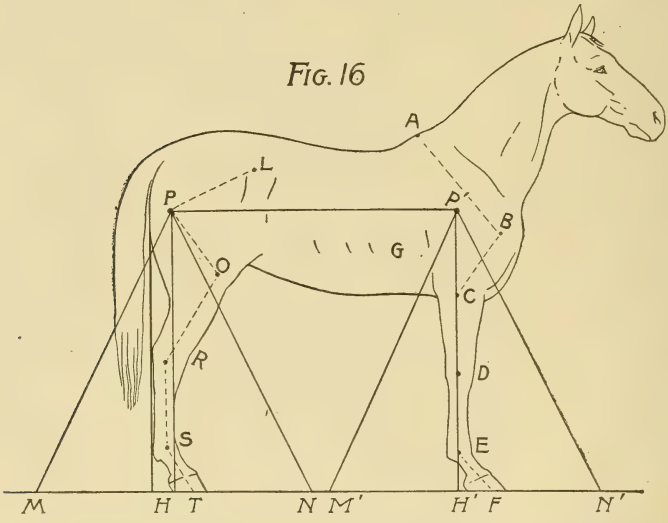


FIG. 16

A B C D E F, articulation of fore part. L P O R S T, articulation of hind part. P, P′, origin or pivot of motion. P′ M′, P′ N′, extensions of fore legs. P M, P N, extensions of hind legs. G, approximate location of center of gravity.

respective pivots of motion P′ and P in the shoulder articulation and in the buttock joint as given in Fig. 16. Such a vertical line runs down the middle of fore legs and passes along front line of cannon bone of hind legs. A further test of the correct attitude of hind legs is a vertical line dropped from end of buttock, and this line will coincide with back outline of hind cannon bone. P′ M′ and P′ N′, as well as P M and P N, exemplify the even extension of legs as they stride over ground. Fig. 16 is meant to show an ideal attitude with ideal

extensions and general perfect articulations of the fore and hind parts of the horse.

Theoretical as it may seem, such attitudes are by no means rare and the pictures of *Sweet Marie* 2:02 and of *Sonoma Girl* 2.05¼ (Figs. 66 and 78), two shining lights of California, illustrate this point to a remarkable degree. The firmness and readiness of such a position of legs must impress every horseman.

It must be left to the eye, more or less, if the motion of the legs, forward and backward, be equal, or if, in other words, they swing pendulum fashion or with equal extension. The rule of "pointing" as ap-

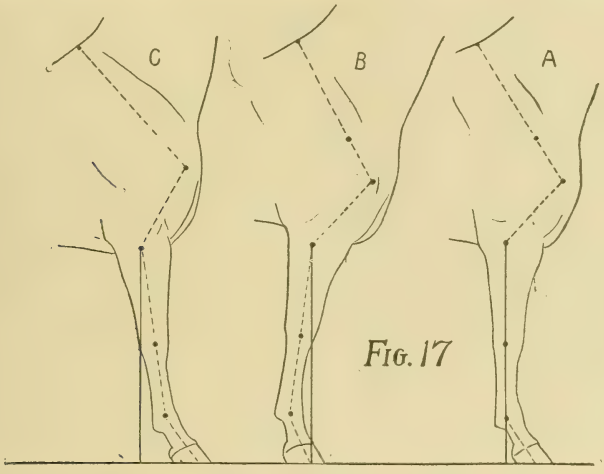


FIG. 17

plied to motion will always hold true. For the fore legs and hind legs there are in each case two faulty positions as given in Figs. 17 and 18. Positions A, A stand for the normal and B, B for pointing in and C, C for pointing out. What the swing of each leg will be when in motion can be readily observed and is indicated in Fig. 15; and what can be done to overcome the faulty tendencies, if a remedy be possible, will be shown later.

There is no doubt but that such faulty tendencies either in fore or in hind legs may occur in subjects of great speed, for the efficiency and energy of the horse, both in conformation and in motion, is largely the result of proper compensations; that is, one deficiency is often counterbalanced or entirely removed by a greater development else-

where. The faulty angularity of the joints may sometimes be counteracted by powerful muscles, tendons, etc. After all, the results that we must try to reach must show a harmony of motion, action and extension, or, in other words, a proper balance. Balance, as we shall see all along this investigation, is but a study of compensations for the defects as they generally exist in even the best trotters and pacers. The great ones of these are to the manner born, like genius, but a great many more are made by the patience and ingenuity of trainer and shoer combined, and it is the purpose of this book to aid both in that accomplishment.

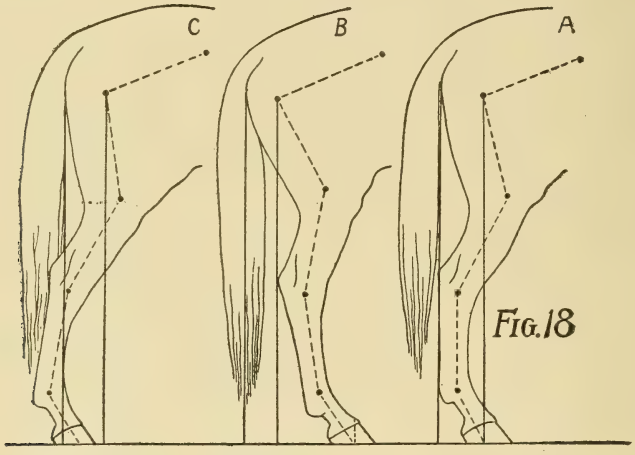


FIG. 18

Having considered the attitudes of "pointing", as well as the extension of legs arising therefrom, we naturally come now to the elevation of the feet or action of the legs. The action is effected on curved lines of various magnitudes. As a rule, the action of fore is greater than that of hind legs. The standard or ideal action should show an approximate equality between the two extremities; in other words, that action will show the most harmony of motion in which the elevation of the hock action will be as high or nearly as high as the knee action. The greater power of flexion of knee over that of hock will always prevent the elevation of the hind feet from being greater than that of the fore feet. On the other hand, the hind leg, being more movable or more loosely hung than fore and at an opposite angle of flexion from that

of the fore leg, is apt to reach forward with greater ease than fore leg. Hence we shall see later that to prevent interference between the extremities it is sometimes as necessary to *decrease* the *extension* of hind as it is to *increase* the *extension* of fore; in other words, to equalize the hock and knee action. Such, it seems, were the endeavors and the results of Palo Alto Farm and of the Electioneer family of horses. It is, in fact, a very reasonable and sensible view to take of the action and gait of the trotter.

It may be of interest to state that increasing the action of one extremity by one means or another tends to decrease the action of the other extremity. If by toe-weight or heavy shoes we effect greater folding of fore legs and consequent higher elevation of feet, we seem to create a tendency in hind to remain closer to the ground; and, vice versa, if by heavy shoes and calks or squared toes we effect the greater action of hind and consequent greater elevation of feet, we seem to diminish the action of fore legs or elevation of their feet.

The fore legs seem to have the mission of props to keep the horse from falling and the hind feet are meant as the great propellers when at speed. When we consider the forward angularity of hind limbs we can see how their tendency becomes one of forward action, while the backward angularity of fore limbs tends to a greater fold of the elbow and knee joints. In fact, though the hind legs are hung more loosely they are not quite as well adapted for high elevation; while the fore legs, more firmly or stiffly set in forequarters, are compensated therefor by a greater ability to fold or bend. Photography has proved that the fore legs also act as propellers, and the evidences of the tracks on ground will prove as much; and in a general way it may be said that the action of the hind is from one-half to two-thirds of that of the fore. The less the difference in action between the two extremities the more harmonious and regular will be the entire motion of the horse at speed.

As mentioned before, Muybridge first demonstrated by his instantaneous photographs at Palo Alto Farm that the various positions of the horse in motion were totally different from accepted beliefs; and it is well worth while to recall his results. I would, therefore, like to

present to the reader a few outlines of such series of pictures in order to enable him to judge for himself of the motion of the trotter; but the main purpose of doing so is to show the curves of elevation or action of fore and hind legs. These deductions are my own plotting of the various points in motion. By connecting these points with the intermediate line or curve of motion we arrive at a presentation of the line of motion, called the *trajectory.*

It is appropriate to quote Dr. Stillman in his "The Horse in Motion," on the elevation of the horse while in motion.

"In the *slow* trot the action of the muscles is not sustained and the bony levers are allowed to resume their normal angles. At each half stride the center of gravity *regains* nearly, if not quite, its *elevation;* but as the horse *increases his speed he lowers the center of gravity;* and in so doing enables the extremities to reach farther and sustain the weight longer, while the rapidity of the movement of the body gives it a momentum that forces the suspensory ligaments to yield and the angles to close to the requisite degree to prevent to alternative of the *deflection* of the *trajectory* or the crushing of the limb; and if measurement be taken of the height of the horse at different portions of the stride it will be found that it is least when it would seem that it should be greatest; that is, when it passes the perpendicular, or that point where the supporting limbs are shortest."

In Fig. 19 we get the general idea of the elevation and extension of the trajectory or curve of motion which the foot of the horse takes from one contact of ground to the next. We *assume* here that the greater the elevation the greater the extension.

This illustration serves to show the accepted belief about extension of feet or legs; that is, the higher the elevation the greater the extension. In a measure this is true, if other conditions, such as muscular development, "pointing" and manner of shoeing, do not counteract it.

But from proofs by instantaneous photography and from actual experience, as will be shown in later chapters, it is generally true that the higher the elevation of action the less will be the extension. Figs. 20 and 21 will serve to illustrate the point on this subject. With

higher knee folding we are likely to have a shorter extension from A B to A C; and with the high action of hock joint we are likely to see a backward reach and a lessening of forward extension from A C to A B, as seen in Fig. 21.

There is a general belief that extension proper is affected by and concerns only the fore legs. The use of weights is too often

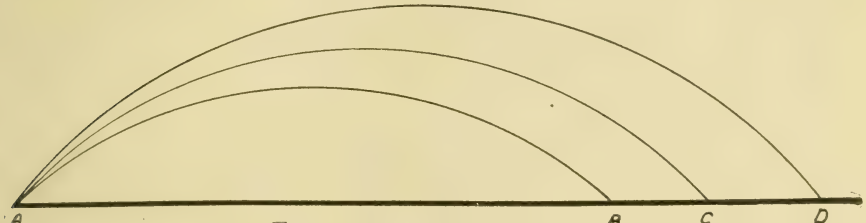


FIG 19.

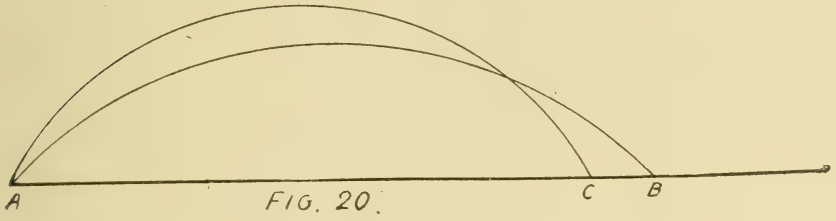


FIG. 20.

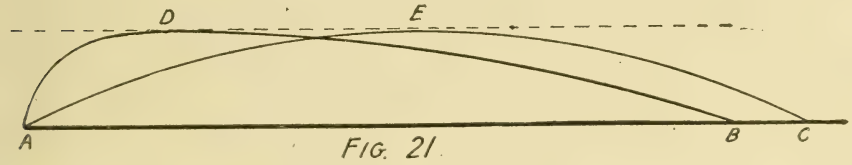


FIG. 21.

resorted to as a means of extension; but the effect is really not quite what it is claimed to be, as we shall see later on. And, furthermore, I hope to prove to the reader that the proper extension of fore feet depends a great deal on the proper and equal swing of hind legs and especially on the proper backward reach or propelling power of the hind legs.

We are not dealing with a biped but with a four-footed animal, and the attempt at regulating extension or stride or quick and slow

action should always take into consideration the movements of the hind legs as well. Horses move in all sorts of ways, it is true, and have speed, but many would not come up to the standard when speed and quality of gait are to be transmitted to their next generation without a step backward in their development. There are many freaks and many queer examples of compensations for deficiencies, but all of these are not proper factors for the greater evolution of the trotter and the pacer. We must have ideals regarding their gait as well as their speed. Mere speed can not, and in time will not, be the only criterion of their fitness as progenitors.

By kind permission of the publishers I offer my own outlines of pictures taken by E. J. Muybridge thirty years ago, as found in that excellent work "The Horse in Motion," by Dr. J. D. B. Stillman, published many years ago by Ticknor & Co. of Boston. The publishers have still a few copies on hand and it is a pity to think that all plates have been destroyed and the work is out of print.

The tracings here offered are those of the horses *Occident* 2:16¾, *Elaine* 2:20, *Edgerton* (Abe Edgington) 2:23¾ and *Clay* 2:25, all owned by the once famous Palo Alto Farm some thirty years ago; but the lessons from the motions of these four subjects will remain ever new even though we have progressed in the production of speed.

These four horses are different in action and gait and will serve as types for similar cases in these days. It is well worth while to recall this first brilliant and bold attempt to investigate this intricate subject. A good deal of what is thus presented may be well known to many, but it will bear repetition in conjunction with my subject.

The great usefulness of that unique presentation of the consecutive positions of the same horse in motion renders it invaluable for the student of gait. Nothing like it has ever since been attempted so far as I could find out. And the further fact that the ground line over which those horses trotted was divided into equal divisions has enabled me to also locate the consecutive positions of the feet and by connecting these points to trace the curves of motion, or the trajectories of fore and hind feet. Let me first outline to the reader the apparent characteristics of the gaits of these four horses.

It is said that Occident was found in the streets of San Fran-

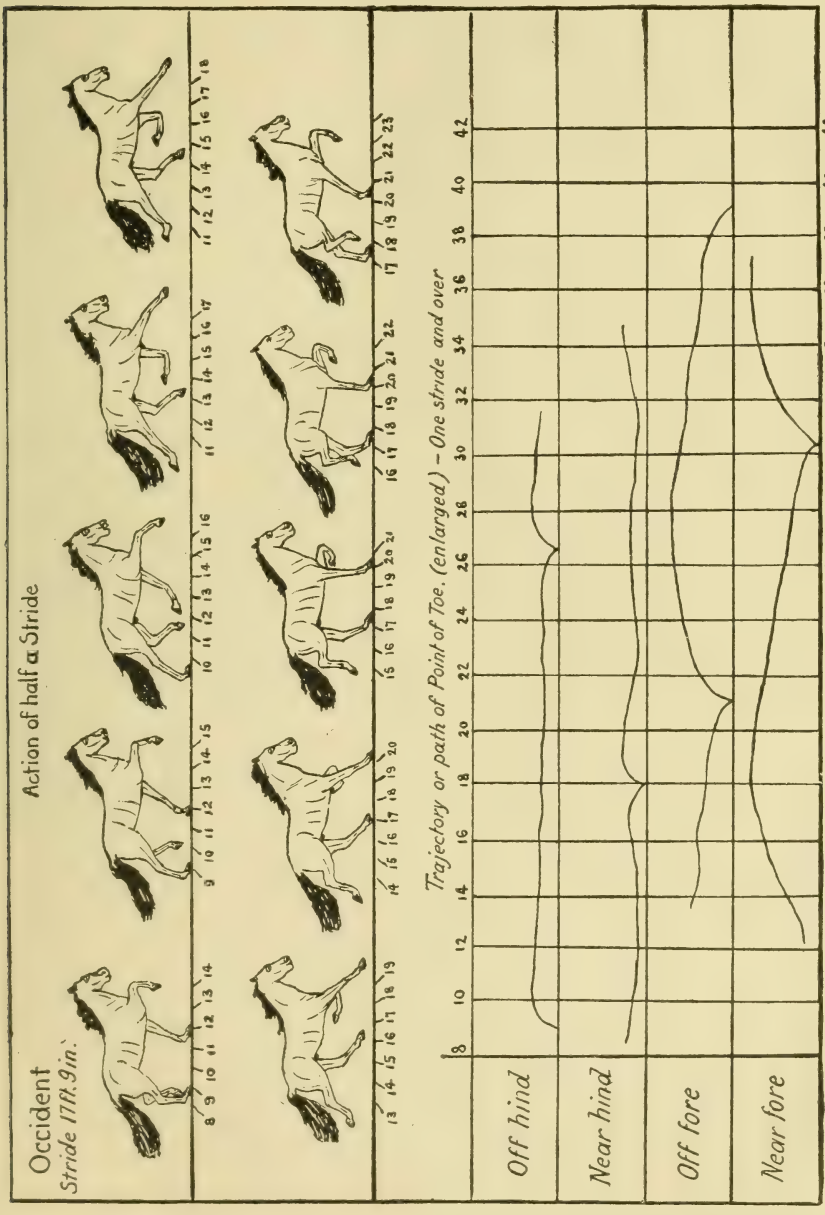


Fig. 22.—Occident 2:16¼.

cisco pulling a butcher's cart, just as recently the trotter Berico, 2:09¼, appears to be a graduate from the hard school of delivery

horses. Such instances often give rise to the assertion that a real trotter will trot at any time under any conditions, no matter how his feet are trimmed or what shoes he wears. It is the call of the gambler who hits upon a lucky combination and mocks all natural laws. Trotters are discovered everywhere by their action and their gameness, but they are not brought to perfection under the system of chance.

In Fig. 22 are given the outlines of Occident in motion with a stride of 17 ft. 9 in. There will also be seen the elevation of fore and hind feet taken at point of toe and the comparative action or elevation of knee and hock taken at the point of these joints. These curves or trajectories are taken from the pictures directly, the various points in the positions being connected by a continuous curve. In the case of fore and hind feet these curves have been enlarged to bring out the outlines better; but in knee and hock action the lines of motion follow the pictures exactly and are applicable to them.

Occident stands apparently as a type of the resolute trotter, with much display of action, especially in front, his hind action being a little out of proportion with front action. The forward reach of fore legs is of the impressive kind which tends to greater extension. When folding the knee there is no sudden drop of foot but a bold unfolding of that joint and a straight reach forward with foot. The path of feet in the illustration will prove this; and yet he lacks the goose paddle out behind which gives the trotter his ability to hurl himself forward. There is a good upward and forward action of hind legs but also a little "pointing" forward or trotting under behind. All in all, Occident would stand for the ordinary resolute trotter of to-day with the usual fault of inequality of fore and hind action.

Occident was by Doc 449 and was a star at the time when in 1873 he took his record. The yearly Occident stake for three year olds is aptly named after him for his gameness and courage.

We now come to the so called Electioneer trotter in Elaine 2:20, by Messenger Duroc out of Green Mountain Maid, the dam of old Electioneer. Here we have that peculiar and nearly equal extension forward and backward of the fore and hind legs. There is a nearer approach of elevation between the two extremities. The display of

action in front is not so impressive as with Occident, but the extension is as good. Behind we have the strong propulsion by means of the goose paddle backwards. The lifting of hind feet is more sudden and

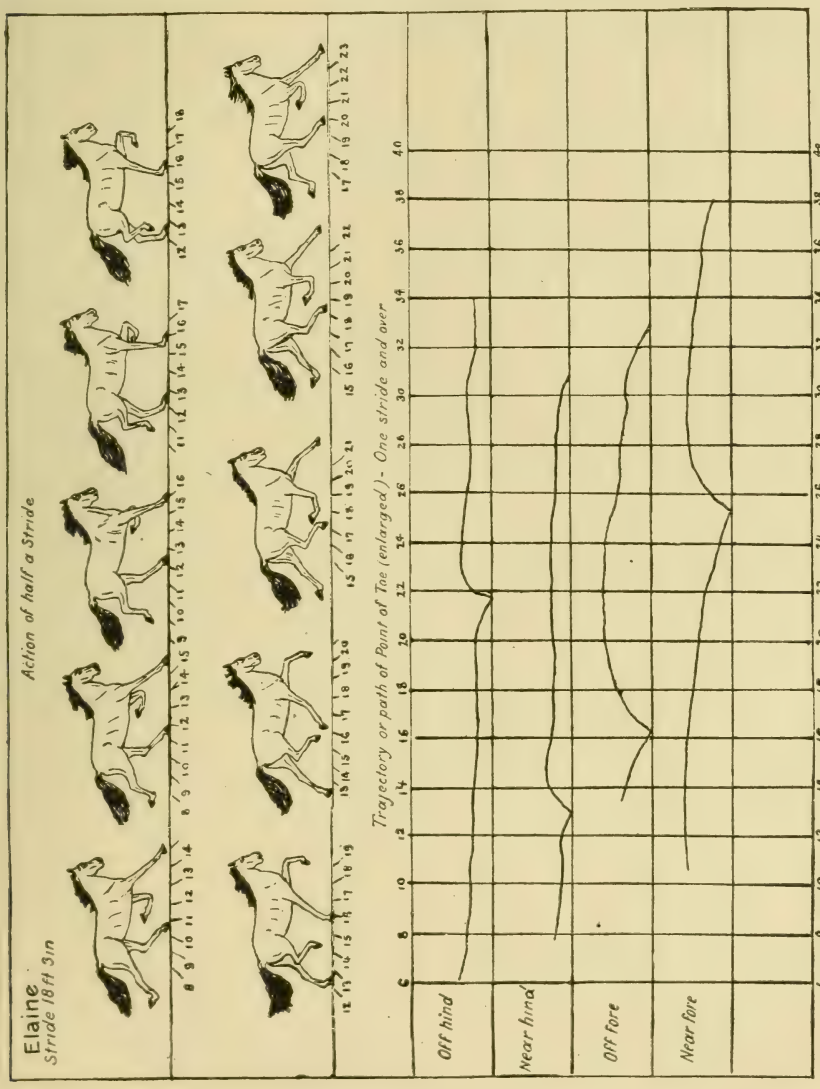

Elaine
Stride 18 ft 3 in
Action of half a Stride
Trajectory or path of Point of Toe (enlarged) - One stride and over
Off hind
Near hind
Off fore
Near fore

Fig. 23—ELAINE 2:20.

higher than with Occident, and because the fore feet are not so greatly elevated we have a more equalized action and extension at the two extremities.

Though often called a "low" gait it is not in reality so; but there is no waste of energy in excessive elevation or extension of the feet, hence it strikes the eye as being a gait without loss of motion or a gait with some reserve force back of it. All in all, it is the best form of standard gait for the trotter in my opinion, because of those characteristics.

In Fig. 27 I have endeavored to compare the relative elevation of knee and hock joints and their rotations. The lines enclosing the hock action are the limits of elevation of knee action. Generally the hock joint stands higher than the knee joint, and generally, and in spite of that fact, the limit of hock action does not equal that of the knee. In the mare Elaine, however, it does so nearly; and this is the point at issue with evenly divided action and extension. It is this lower action or elevation in front and the more than ordinary elevation behind that causes the impression of a "low" or creeping gait, when in fact it is a gait of exceptional value for speed, with a view to soundness, a free head and a sure footing.

The third object of comparison is a horse called Edgerton in the book "The Horse in Motion," but which was probably Abe Edgington instead, because on the photograph of Muybridge therein produced he is shown as a gray gelding, which Abe Edgington was. He was by Stockbridge Chief Jr., and had a record of 2:23¾, got in 1878.

In studying his gait we arrive at the conclusion that he belongs to the more ordinary class of trotters, with only medium action and a tendency to stand under in front as well as behind, as was shown in Figs. 17 and 18 under B. It may be noted in the illustration how hind foot passes on outside of fore, as in the second position. This is a faulty way of going at great speed; for to-day the "line trot", so well advocated by the owner of Palo Alto Farm, and so well exemplified in the Electioneer family, is the only rational trot whereby the horse can go fast and safe. By line trot is to be understood a way of moving hind leg in nearly the same path as the fore leg on the same side; at any rate, the fore on that side must be out of the way for the hind when the latter reaches forward. In Edgington the folding of knee is

pretty fair, though the hock action is jerky; that is, there is a sudden lifting followed by a drop to a low elevation of foot, giving the ap-

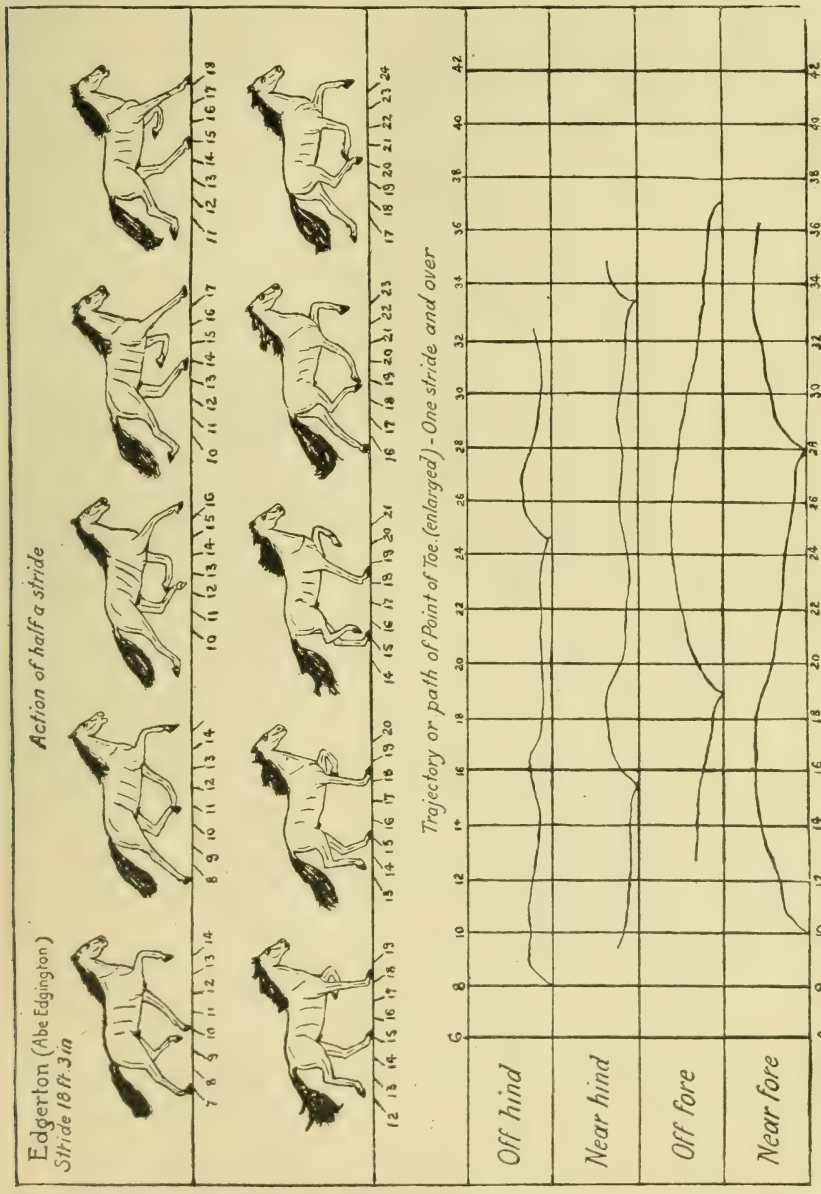

Edgerton (Abe Edgington)
Stride 18 ft. 3 in
Action of half a stride
Trajectory or path of Point of Toe (enlarged) - One stride and over
Off hind
Near hind
Off fore
Near fore

Fig. 24—ABE EDGINGTON 2:23¾

pearance of a low hock action. The trajectories are evidence of such a gait, as we find it with the better class of trotters.

In the study of Lou Dillon's gait we shall see that with her manner of propulsion the question of interference of hind with fore feet does not apparently cut any figure. For, inasmuch as the fore feet cross over each other, they are out of the way of the approaching hind at the critical moment. There is no "line trot" here, although the hind feet move in nearly straight lines; but the fore do not move in straight lines and effect their propulsion from the opposite side.

The last of these series is Clay 2:25, by St. Clair, a short-coupled and rather leggy horse, with all the faults of gait which such a horse is apt to be guilty of. With a good deal less fold of knee than the previous trotter he has still more of a jerky and sudden elevation of hock action, due to the fact that his reaching backward with hind legs is very marked. This sudden elevation is followed by as decided a drop and he just pokes hind leg forward without any further effort to lift leg or foot. Being deficient in knee action, we see in Fig. 27 that knee and hock elevation are about the same in magnitude as those of Elaine. Being leggy and short-coupled and probably standing under in front and pointing forward with hind, he passes hind legs on outside of fore, much more so than Edgington, and this is a fault not tolerated to-day and one that never promises much speed or an even gait.

Finally, there is an unknown pacer given whose gait is not of the best and lacks extension to show its characteristics at speed. It shows, however, the low elevation of hind feet, not only as compared with that of fore, but also by itself; and as a rule the pacing gait is of a more creeping nature behind than the trot is or ought to be, and in the lateral extension the hind feet are generally inside the lines of motion of the fore. This is the reverse from the lines of motion of the trotter and this closer approach of the hind adds to the tendency of their low elevation.

This pacer has, like the trotter Clay, the fault of lifting his hind foot off the ground before its correlated fore foot, which often tends toward single-footing, or at least to an uneven or rough gait. In Elaine, Occident and Edgington we notice the reverse, namely, that hind foot leaves the ground a trifle later than its forward mate. This is as it should be to insure an even or synchronous contact with the

ground at the farthest point of extension forward. In the above

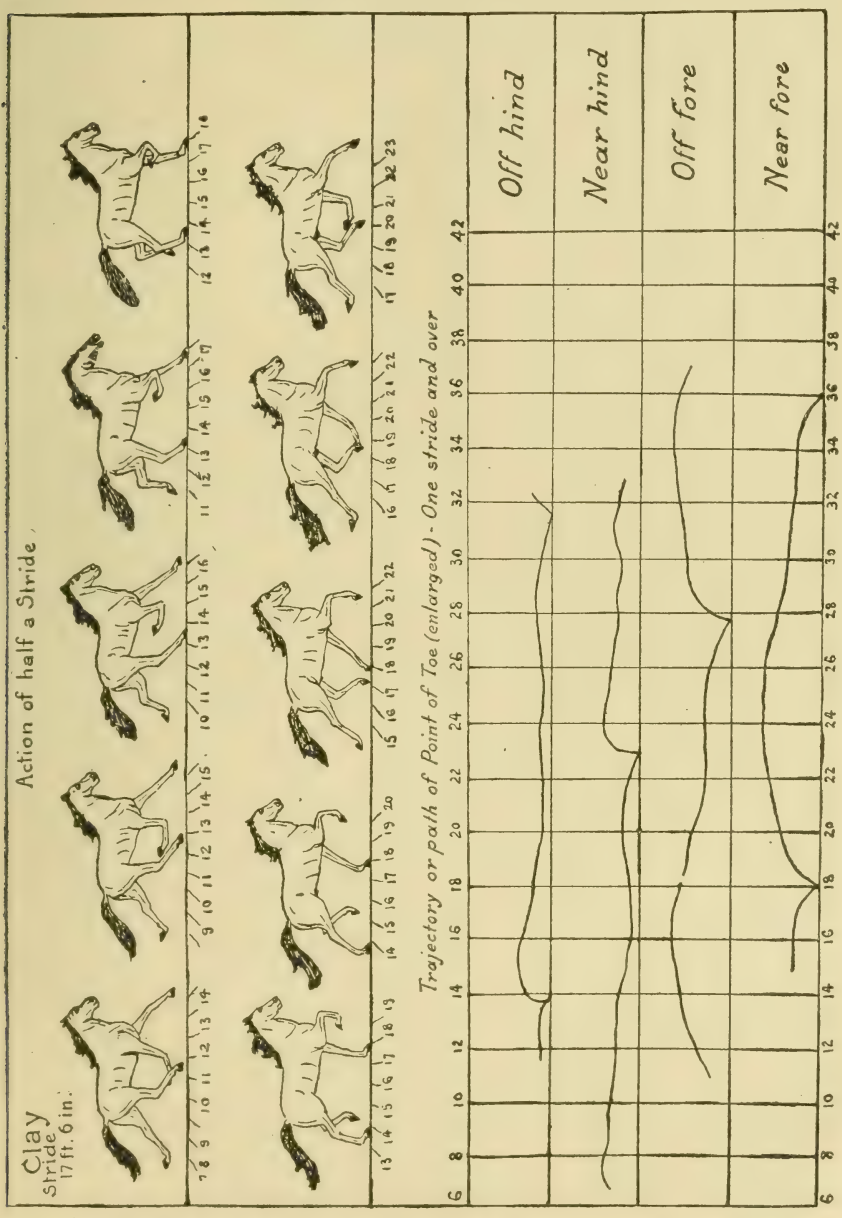


Fig. 25—Clay 2:25.

three cases the fall of the two correlated feet or diagonal mates occurs at the same moment. The fore foot always describes a higher and

therefore longer trajectory or path than the hind foot; and therefore does this retarded action of hind not only cause a greater impulsion forward but also less interference with the fore on the same side and

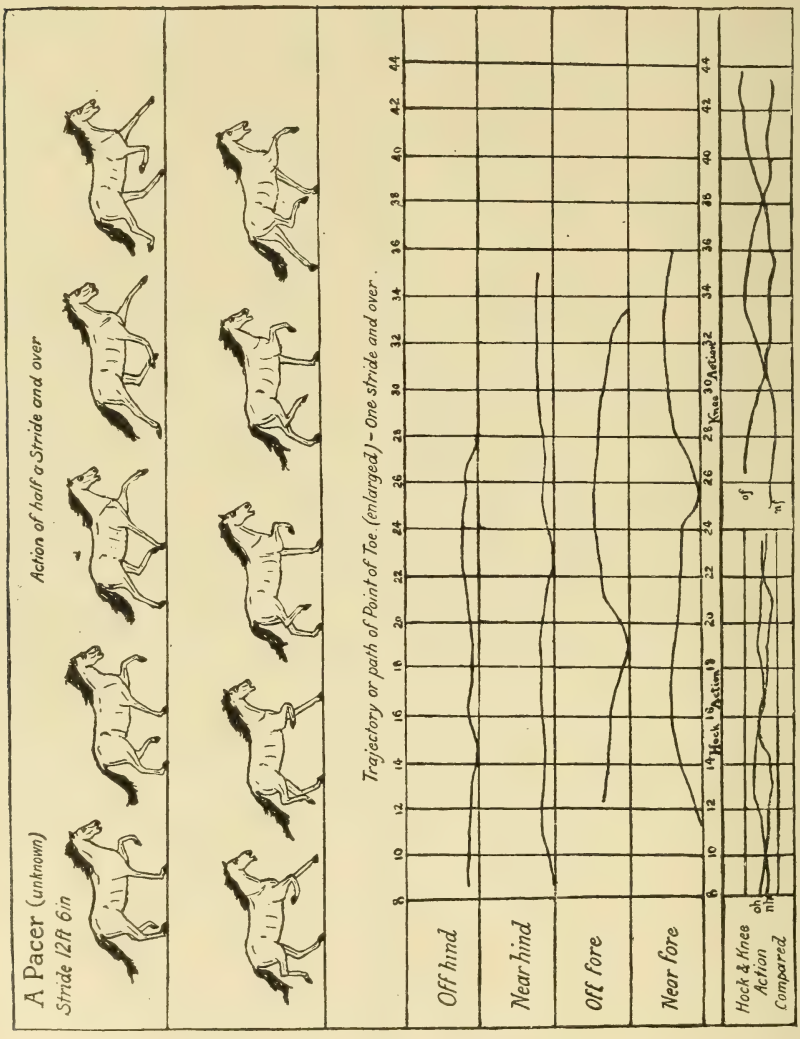


Fig. 26—A PACER (unknown)

a more even action with its diagonal mate. In other words, it becomes apparent that the greatest fault in hind action of both trotter and pacer is its lack of backward extension, or, what amounts to the same thing, its excessive pointing forward or standing under with hind feet.

In Fig. *27* appears a comparative schedule of the knee and hock

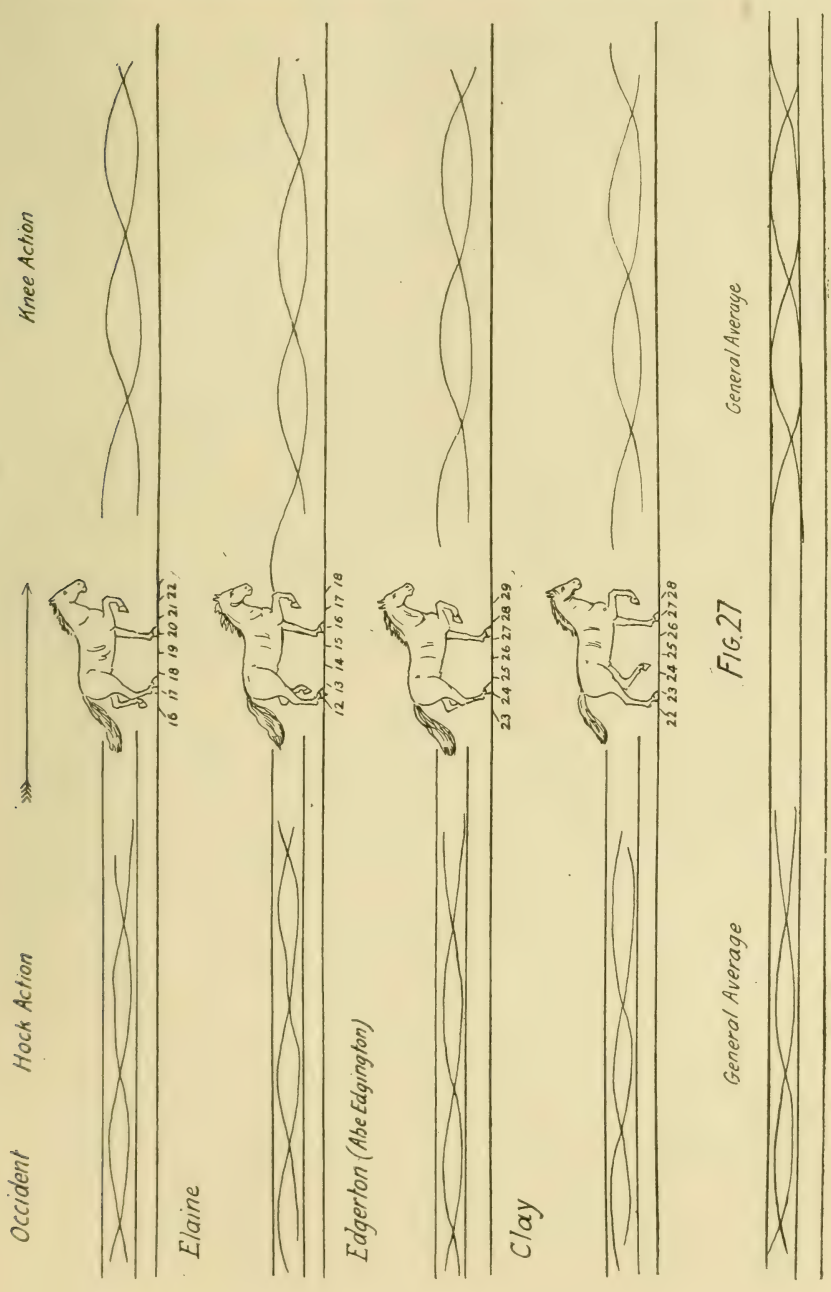


FIG. 27

action of the four above named trotters. It shows the difference of positions of both these joints as regards distance from the ground. In all cases the hock joint is located higher from the ground than the knee joint, which is a common observation with horses.

In a later chapter the details of such comparative elevation are fully explained and illustrated. The scope of knee action is here indicated by the parallel lines enclosing the curves of hock action. From these plottings it may be seen that Elaine comes first in developed action in front and behind; Edgington should be second for a similar reason, but he shows a somewhat less developed hock action with more forward than backward extension, together with a consequent interference. Occident is a good third, even with his excessive knee action and low hock action, his gait being a sample of the endeavor to remove the fore feet from the interference with the hind feet by means of excessive action in front; and lastly there is Clay, whose indifferent knee flexion but good hock action seem to cause trouble by speedy-cutting, for his hind feet are seen to pass the rather sluggish fore feet on the outside. This is a gait that can in no way be recommended, but the animal's conformation is largely at fault for that defective propulsion.

At the bottom of Fig. 27 I have endeavored to present the average of the movements above referred to, and from this the reader may get an idea of the comparative action in front and behind. These studies, when applied to actual cases, have always indicated that it is easy to increase the knee action or to decrease the hock action. These are the natural tendencies of the movements of these joints. Far more difficult it becomes to equalize the action of the two extremities; that is, to *increase* the hock action and to *decrease* the knee action. As all trainers know, proper extension counts for more than action; that is, proportionate reaching forward with the fore and backward with the hind legs is the secret of a regular and fast gait. Much attention has been given to increase the extension of fore and but little to the propelling power of a well placed hind foot as it reaches backward in its last effort to fling the body forward. I shall touch upon this matter later on.

There is one more comparison of action that deserves notice. It

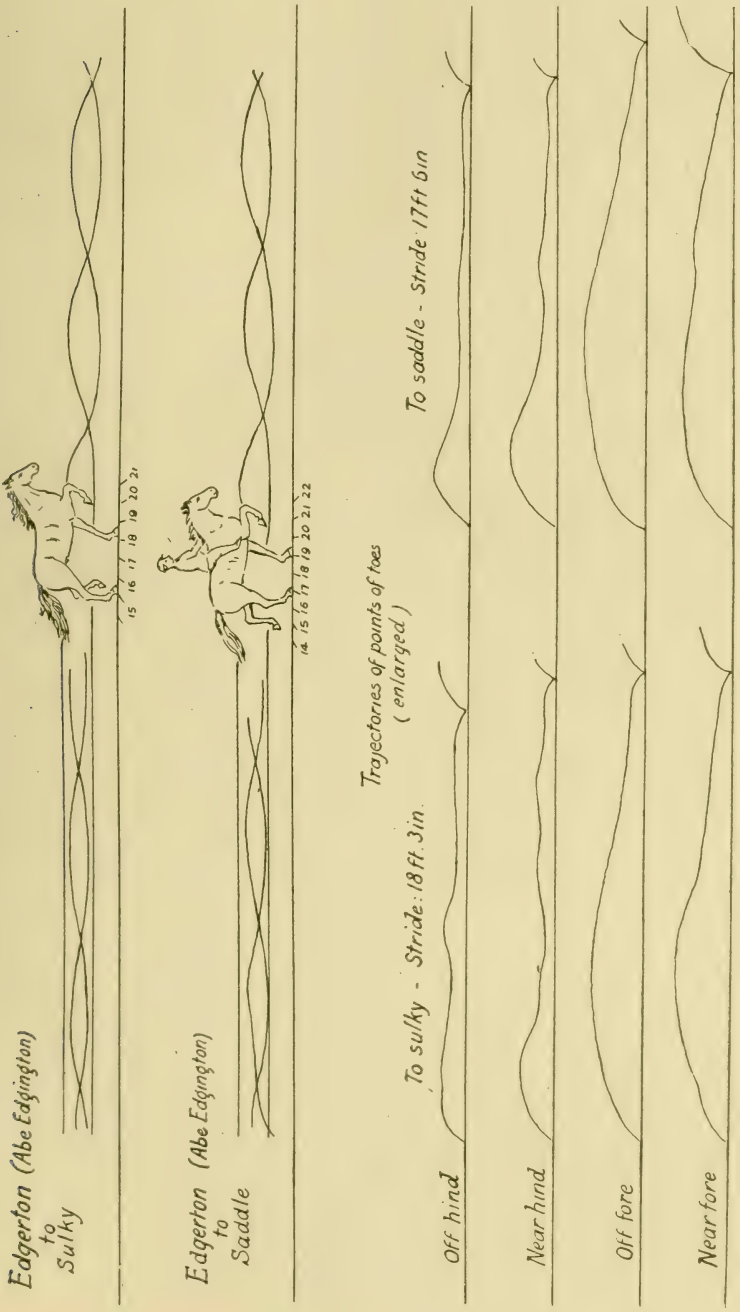
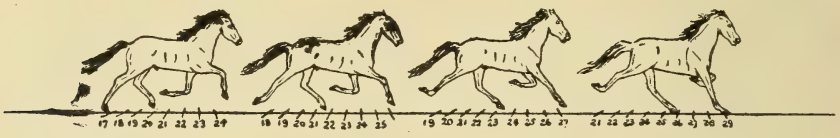

Hock Action
Knee Action
Edgerton (Abe Edgington) to Sulky
15 16 17 18 19 20 21
Edgerton (Abe Edgington) to Saddle
14 15 16 17 18 19 20 21 22
Trajectories of points of toes (enlarged)
To sulky - Stride: 18ft. 3in.
To saddle - Stride 17ft 6in
Off hind
Near hind
Off fore
Near fore

FIG 28

is that of the horse Abe Edgington (Edgerton) to sulky and to saddle, as given in Fig. 28. With the superimposed weight of a rider the action of knee decreases and that of hock increases in elevation. The hock joint by depression of weight is nearly on a level with knee joint and yet its elevation is as high as in the trial to sulky. But the most remarkable change in action is the sudden elevation of hind when leaving the ground, as given in the drawings of trajectories. A few positions of the horse in motion under saddle are also given in Fig. 29, when the sudden elevation of hind feet becomes a fact to the eye, due to the greater backward reach or extension than there was visible in the trial to sulky, and with this backward action disappears the tendency to speedy cutting. The trotter clears or trots under the fore with his hind feet. The weight on the back prevents a pointing for-



Abe Edgington to Saddle - *Note backward action and extension*

Fig. 29

ward of hind and seems to extend fore feet. There is an indication in this effect which points to a similar effect of letting down the head of a horse or of heavy shoes behind or shoes that will favor easy backward reach. This will be investigated in later chapters treating on the measurements of the gaits.

In summing up the points of importance shown in these illustrations I beg to have the forbearance of the reader for the imperfections of the drawings. They were prepared with all the care and skill at my command, but since the originals were not quite perfect the faults are not altogether of my own making. In the main and principal features the presentations and plottings are correct; it is only in the fine outline and execution where they lack perfection.

The points at issue are all directed to nearly equalize or balance the fore and hind actions. It is a well known fact that fore action

is always greater than hind action, but it may be apparent to the reader that it has been shown that there is an adjustment possible between these actions which will bring these two extremities into proper harmony. The high cleaving of the air by the fore feet is pure loss of motion and energy; while the low, shuffling gait of hind feet shows a lack of energy well to be considered. The former seems to produce the latter manner of motion; and the efforts toward a more perfect gait should be directed toward a lessening of forward action and an increase in the backward action of hind, whereby propulsion is effected and interference prevented. And, in fact, wherever an attempt has been made by me to bring that about there resulted a better and smoother gait and—as it should be—greater endurance and speed.

It seems, therefore, advisable to set up a standard of action, and among those analyzed above Elaine's comes nearest to that standard. There are still many advocates for the gait which Occident exemplifies, but one cannot pass on it as nearly so perfect as Elaine's, though, of course, it is energetic and powerful and apparently promising of great speed. It is the manner of speed that a great many fair and good trotters have.

The gait of Abe Edgington (or Edgerton) must be judged as somewhat faulty, but also as amenable to correction; for when he was put under saddle his gait improved wonderfully. Here, then, seems to be a case that could be corrected and shod in such a manner that in time the faults would disappear. The trotter Clay presents a conformation that would always balk every effort for improvement. Nature makes and mars trotters and pacers by a faulty conformation, even though the instinct to trot or pace is in the brain. The gait can be regulated and the speed improved up to a certain point, after which there will be a confusion of motion in spite of every effort.

Bearing in mind these side views of the horses in motion we are enabled thereby to detect some deficiency of gait by the eye, and this will aid us to analyze the gait of any horse by the method which I propose to explain in the next chapter.

CHAPTER IV.

RECORD OF THE TRACKS ON THE GROUND AND THE IMPORTANCE OF AVERAGES.

With animals in motion we must ask either the camera or the tracks on the ground for the story of their gaits. What Muybridge, years ago, showed to an astonished world was the profile view of horses and other animals in all stages of motion. While the camera has thus given to the student the key to animal locomotion, it is not always practical to apply its revelations to every case. After having studied the principles of such exact knowledge as photography revealed, and leaving the eye to judge according to such facts, we shall discover the actual condition of a gait only in the record left by the tracks on the ground. While "he who runs may *not* read" in this case, it may become convincing during the investigation that he who studies a little may certainly read the meaning of this record.

Muybridge and Roberge have done a great deal to analyze and simplify the motion of the horse, but added to that knowledge should be the study of the tracks for *each individual case.* This recorded gait on the ground, when reduced to figures by means of the tape-line and by means of simple calculation for general averages and variations, will soon produce order out of chaos and give as clear an idea of the horse's action and extension as is possible to acquire. The main features of the measurements and calculations are not beyond the reach of any intelligent person, even if all the details of such an investigation as formulated in my small manual books are not fully carried out or computed.

Many people make much of the so-called *stride,* or the step the horse takes with each leg. I want to say from the start that the stride for all four legs must be the same; that is, the stride of a certain gait

is, say, 18 ft. That means that each leg strides that distance. One leg may vary more than another leg, but in the sum total the average for each leg's stride must be 18 ft., or else the horse will break into a run and cease trotting or pacing. To get at the stride of a particular gait, or of any horse at any speed, we must, therefore, measure the whole distance of such a trial, and compute from this the stride of each leg. If for convenient calculation we choose 20 strides for each leg as sufficient to indicate peculiarities of gait, we have for the average this total of 20 strides divided by 80. *This is the average stride for that horse at that particular gait.*

There are, however, irregularities of gait which are caused either by bad or indifferent shoeing or by a faulty anatomical structure in one or more limbs, such as a shorter leg, a club foot, etc. Such deficiencies in stride are found by this method to consist of variations in stride. The disturbing leg falls short of average stride, and when recovering lost ground exceeds such average. The absence of excessive variations in the strides has a great deal to do with the regularity and evenness of gait. Later on we shall see that the variation from average, in the fore and hind legs, has a different meaning respectively in fore or hind extremities.

The variations lead us to the question of extension; for, where the variations are different between either the two fore or the two hind legs, there must of necessity be a different extension or placing forward of foot. With almost all trotters or pacers the same habit prevails as with the runner, and that is, one foot is preferably put a little ahead of the other in front; but this extension of one fore ahead of the other has as a consequence the simultaneous extension of hind. In other words, an irregularity in front is likely to cause one behind, because of the intimate relation between fore and hind legs. In the trot it will be the hind foot of opposite side, and in the pace the hind foot of the same side. As the difference of extension between the hind legs becomes greater, the danger of interference with fore legs increases. Fig. 30 will illustrate the points here raised for the trot and Fig. 31 for the pace. If, for instance, in the trot, the fore foot A is with preference placed ahead of fore foot B, it follows that the hind

foot D, moving with it at the same time, is placed ahead of the other hind foot C. If this were not the case and the diagonal feet did not reach the ground at the same time, the horse would not be trotting but single-footing or running. So in the pace, where A and C move together, and B and D, the hind foot C, moving with its lateral mate A, must be placed ahead of hind foot D. It must be noticed that Figs. 30 and 31 only indicate the tendency of such differ-

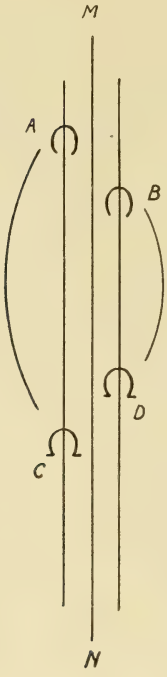


FIG. 30.

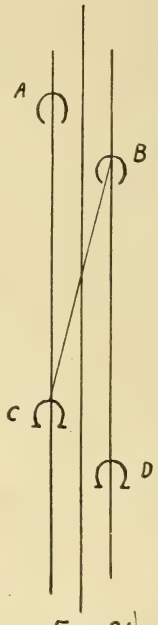


FIG. 31.

ence of extension, as if the horse were pointing that way when at rest. In Figs. 32 and 33 we see the actual record of the tracks on the ground for the trot and the pace. Applying thereto the tendencies of unequal extension as indicated above, we shall find the actual position of feet as indicated by dotted outline of tracks. In the trot, Fig. 32, we have a possible passing of hind foot D on outside of fore foot B (speedy cutting) as illustrated in the case of the horse Clay, Fig. 25. And in the pace, Fig. 33, we have a possible passing or interference

(cross-firing) of hind foot C with fore foot B on the opposite side, as seen in the case of the pacer, Fig. 26.

In the square trot as well as pace we often find a tolerably small difference of extension between fore and hind feet. The shifting from one foot to the other may now and then alternate, but if this difference

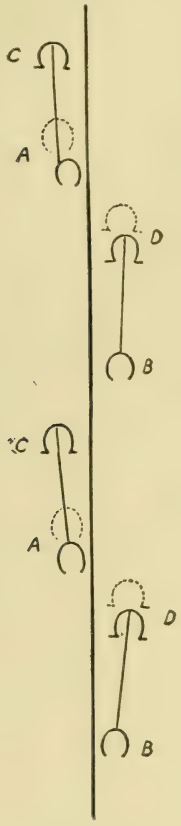


FIG. 32.

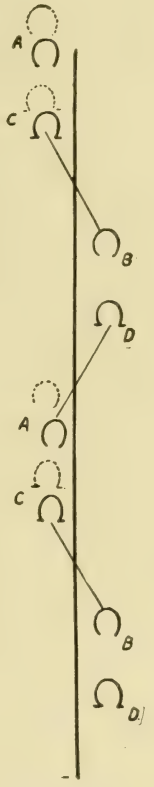


FIG 33

is small it becomes negligible in our investigations. We cannot possibly insist on an absolutely pure and regular gait and must at all times allow for the condition of ground and the great effort for speed; so that, when such a difference is only an inch or two, it need not alarm us, but when it becomes a foot or more there must be something wrong, as in a rough and irregular gait.

The ideal gait for the trot, as well as for the pace, lies in the words: *equal extension of all four legs.* Anything short of that may be classed as irregular and subject to a possible correction.

All my endeavors to reduce these two gaits to a basis of purity have brought out certain points which will be demonstrated by various experiments. The very fact that these experiments were tried on different subjects, and that the principles involved were applied and yielded definite and practical results, may give the reader some idea of the usefulness of this investigation. It may strike the reader as a laborious process to establish the facts of a gait; but are not facts better than guess work?

Balancing the horse in motion should be based on exact principles and these principles should be deducible from careful experiments. This is, to my mind, the only rational view to take of the matter.

I anticipate criticism to the effect that this method of measurement is not practical. To be sure, it requires some actual work in the field and some mental effort at figuring; but the time so spent will be far less than the time used up in endless, haphazard trials, with all the guesses and the errors of visual observation.

This method is not given as a cure-all, by any means, but merely as a correct indicator of faults in gait. The certainty of exact measurements enables us to get at the facts in the case. When we once know the cause of disturbance, or have any indication of it, we can proceed at least with intelligence to correct that disturbing cause, if that be possible. No claim is set up either of a cure following post-haste on such a detection of a fault. *Time is the most important element in correcting a faulty gait.* It should be remembered that a change in shoeing is not immediately effective of good results, and that the effect of a previous shoeing or paring of hoof becomes part of the effect of the last shoeing and paring. For, the adjustment of muscles and tendons to such a change does not, without possible injury, occur on the spot. Hence the importance of a continual record of the treatment of the foot and its results. This means a steady progress and an enlightenment on the peculiarities of the subject's gait, such as haphazard guess-work can never accomplish.

There is, however, a method of making some horses acquire a fair gait, outside of a definite plan of improvement. Many horseshoers have pursued the same course, namely, that of *fitting the hoof of the horse to the shoe* that is supposed to improve the gait. By continued application of a preconceived plan as to the needs of a horse for a good gait, the animal is supposed to adapt itself to these set requirements. It is not *always* effective and smacks of the "root-hog-or-die" treatment. With a large expenditure of time, it often amounts to nothing but hope deferred and a blind perseverance.

In thus defending a rational method to ascertain not only the conditions that exist but also those that are wished for in the improvement of gaits, I do not claim that in offering this method of analysis of gaits there goes with it a prompt and immediate remedy or recommendation of shoeing. I doff my hat to the skilful American farrier. He is bound to find a remedy when *definitely* told where the fault lies. He cannot, however, be expected to know the animal's gait or hit the right thing by guessing at it.

Take, as an example, the instructive book on shoeing by William Russell. He has demonstrated in a general way the effects of certain shoes on the gait or manner of motion of the trotter and pacer. He insists that each case is separate from others and requires special treatment. This means that each case demands almost endless experimenting, with no assurance of knowing the reason why the final adjustment of balance is the correct one. Roberge followed him with a more reasonable theory by laying stress not so much on the *make of the shoe* as upon the *shape of the hoof*. While the making of complex shoes reflects highly on the art of shoeing and the ingenuity of the American farrier, the principle of controlling the motion by the shape of an ever growing hoof, and of thereby simplifying the shapes of shoes, carries with it more conviction. With full recognition of the eminent work done by these men, and for that matter by the men who follow their principles, there was to my mind a great need of a method to establish the facts of observation upon which they base their conclusions.

The instantaneous photographs of Muybridge and my plotting of

those curves of motion of the feet, as found in the previous chapter, first proved to me the irregularity of such motion and the need of ascertaining by means of general averages the variations of a gait. I found later on that the two eminent Frenchmen, Goubaux and Barrier, had ingeniously investigated the motion of the horse in their excellent work "The Exterior of the Horse."

This helped and encouraged me in my investigations to find a method by which proper balance may be more easily found than by guess-work. Though shoeing may be considered an art, the proper correction of a faulty gait must be based on a proper analysis of that gait. There may be an infinite variety of conditions and the relations between the four legs may be very intricate, yet there ought to be some logical deductions possible in each case, provided the actual facts are put down in black and white. From such a series of experiments I hope to give to the reader some simple generalizations. Should, however, the reader still insist that each horse is a case by itself and doubt the general application of such generalizations, he can always, by this method at least, find the relative effect of each successive shoeing for that horse, and make the necessary changes to improve the gait of that particular animal.

In looking at the tracks on the ground or the impressions left by the shoe, we must judge of their nature first by the actual contact with the soil. The ground over which a trial for this purpose is to be made should not only be harrowed, but also be hand-raked so as to present a reasonably smooth surface. A smooth, frictionless and easy gait, or that of a horse well balanced, should show even and firm impressions on the ground of the four feet, *without any slip or concussion.*

Whenever there is any sliding or a marked hardening of soil at any point, and a repetition thereof, there is also an irregularity of gait and a difficulty of action. Notes should be made of such *repeated* concussions, because this shows a fact of a deranged action.

Now then, our horse has just moved over such a prepared piece of ground, practically level, for a distance that should give us 20 strides for each leg, as before mentioned. Let us then take a 100 ft. tape line and put its end-ring at the *toe* of near fore by means of a

surveyor's pin. We pay it out to the end and place another pin at the 100 ft. mark. Going back to the start there is now to be recorded the consecutive measurements of the four feet. By means of an ordinary small blank book ruled as in Fig. 34, these measurements can be put down quickly as we go along the line and take readings at the point of

FIG. 34.

MEASUREMENTS OF TRACKS IN FEET AND TENTHS OF A FOOT FROM TOE TO TOE.

Continuous Measurements starting with Near Fore.

	Fore	*Stride*	*Hind*	*Stride*		*Fore*	*Stride*	*Hind*	*Stride*
N	Toe >——>	—	6.40	—	O	201.60	19.25	207.60	19.10
O	9.70	—	15.65	—	N	211.15	19 25	217.25	19.15
N	19.30	19.30	25.70	19.30	O	220.75	19.15	226.75	19.15
O	28.75	19.05	35.	19.35	N	230.45	19.30	236.65	19.40
N	38.05	18.75	44.70	19.	O	240.05	19.30	246.30	19.55
O	47.55	18.80	53.90	18.90	N	249.60	19.15	256.	19.35
N	57.45	19.40	63.80	19.10	O	259.15	19.10	265.55	19.25
O	66.95	19.40	73.	19.10	N	268.90	19.30	275.35	19.35
N	76.40	18.95	83.15	19.35	O	278.45	19.30	284.80	19.25
O	86.15	19.20	92.30	19.30	N	288.20	19.30	294.75	19.40
N	95.50	19.10	102.20	19.05	O	297.95	19.50	304.20	19.40
O	105.45	19.30	111.70	19.40	N	307.50	19.30	314.	19.25
N	114.75	19.25	121.05	18.85	O	317.15	19.20	323.55	19.35
O	124.20	18.75	130.50	18.80	N	326.80	19.30	333.35	19.35
N	134.	19.25	140.50	19.45	O	336.70	19.55	343.15	19.60
O	143.45	19.25	149.90	19.40	N	346.40	19.60	353.10	19.75
N	153.50	19.50	159.90	19.40	O	356.20	19.50	362.60	19.45
O	163.20	19.75	169.10	19.20	N	365.75	19.35	372.25	19.15
N	172.55	19.05	179.	19.10	O	375.25	19.05	381.60	19.
O	182.35	19.15	188.50	19.40	N	384.60	18.85	391.35	19.10
N	191.90	19.35	198.10	19.10	O	394.40	19.15	400.75	19.15

N, near side; O, off side.

toe of each foot. To make calculations easier I found the surveyor's tapeline more practical because it divides the foot into 10 parts. Decimal computations are more readily made and therefore their use recommends itself for this purpose. If the metrical system were established in this country it would simplify matters vastly by ridding calculations of their complex figuring. So likewise here, if we were to figure all

these calculations by means of the twelve divisions to the foot, or actual inches, it would complicate matters and take more time. Decimal fractions of the foot are easily reduced to inches by multiplying by the figure 12; and one-half of a tenth of a foot would read: 0.05 ft.

In all measurements so taken and in all distances so recorded the reader should bear in mind that such distances are always taken parallel to the motion of the horse, even though they are referred to as diagonal distances in some instances, in order to designate the points in question.

Fig. 34 would ordinarily present two pages in an ordinary note book so prepared as indicated. We have to remember two things in recording these measurements, namely, the distinction between fore and hind and near and off side. The rest can be done at any other time and place. In the trot the hind is ahead of the fore foot, these two being together on each side; and in the pace the fore precedes the hind on each side, as given in Figs. 32 and 33.

I present to the reader the gait of Lou Dillon 1:58¼, which, through kindness of Mr. Budd Doble, I had a chance to take when the mare was under his excellent care at San Jose, Cal., in 1905. She was trotting well at the trial and was going at a 2:11 clip on the back stretch where the ground had been prepared for her.

The page in Fig. 34 is divided into two main columns for fore and hind measurements and since tracks occur two on one side, the near and off side alternate in the columns. These are marked "n" and "o" on left side. Auxiliary columns for strides are given to start calculations. The strides are easily computed by deducting a previous near fore measurement from a following near fore, or an off fore from an off fore; and in the same manner the hind feet.

There are three more requirements in the analysis of the gait when thus established by a continuous measurement of tracks, and these are:

(1) The distances between each pair of correlated feet, or the pair that move diagonally together,

(2) The extension or distance of one foot to the other (of either fore or hind); that is, the distance from near to off and from off to near and so on; and

FIG. 35.

(3) The distance which hind foot precedes fore foot on each side, which is to be designated by "overstep."

Let us, however, look at the table of Fig. 34. There are 20 recorded strides, whose average is approximately and quickly found by taking the measurement of the last near fore, namely, 384.60, and dividing the same by 20, which is 19.23 ft.

This is only a rough calculation to get at the stride quickly. For actual computations we shall have to resort to the method employed in Fig. 36, where the sum total of all the strides divided by their number (80) definitely determines the average stride.

FIG. 36.

TWENTY STRIDES AND VARIATIONS FROM AVERAGE (+ AND —).

Average, 19.24.

FORE				HIND			
Near	*Var.*	*Off*	*Var.*	*Near*	*Var.*	*Off*	*Var.*
19.30	+ .06	19.05	— .19	19.30	+ .06	19.35	+ .11
18.75	— .49	18.80	— .44	19.	— .24	18.90	— .34
19.40	+ .16	19.40	+ .16	19.10	— .14	19.10	— .14
18.95	— .29	19.20	— .04	19.35	+ .11	19.30	+ .06
19.10	— .14	19.30	+ .06	19.05	— .19	19.40	+ .16
19.25	+ .01	18.75	— .49	18.85	— .39	18.80	— .44
19.25	+ .01	19.25	+ .01	19.45	+ .21	19.40	+ .16
19.50	+ .26	19.75	+ .51	19.40	+ .16	19.20	— .04
19.05	— .19	19.15	— .09	19.10	— .14	19.40	+ .16
19.35	+ .11	19.25	+ .01	19.10	— .14	19.10	— .14
19.25	+ .01	19.15	— .09	19.15	— .09	19.15	— .09
19.30	+ .06	19.30	+ .06	19.40	+ .16	19.55	+ .31
19.15	— .09	19.10	— .14	19.35	+ .11	19.25	+ .01
19.30	+ .06	19.30	+ .06	19.35	+ .11	19.25	+ .01
19.30	+ .06	19.50	+ .26	19.40	+ .16	19.40	+ .16
19.30	+ .06	19.20	— .04	19.25	+ .01	19.35	+ .11
19.30	+ .06	19.55	+ .31	19.35	+ .11	19.60	+ .36
19.60	+ .36	19.50	+ .26	19.75	+ .51	19.45	+ .21
19.35	+ .11	19.05	— .19	19.15	— .09	19.	— .24
18.85	— .39	19.15	— .09	19.10	— .14	19.15	— .09
384.60		384.70		384.95		385.10	
			STRIDES				
19.23		19.235		19.247		19.255	
			TOTAL VARIATIONS				
+	1.39	1.70		+	1.71	1.82	
—	1.59	1.80		—	1.56	1.52	
	2.98	3.50			3.27	3.34	

Now, looking down the columns marked "stride" we shall see distinct variations from this general average stride. The proper way of computing the general average is by arranging all strides according to the fore and hind feet and near and off side, then adding each of the four columns and dividing the total by 80, which is the total of the 20 strides of all the four feet. Fig. 36 presents such an arrangement of strides and their variations. The strides are easily arranged from Fig. 34, and adding all four columns of strides we have as a total 1539.25, which divided by 80 gives 19.24 ft. as the average stride. Applying this average to each stride of each leg we shall find either an excess or a deficiency from that average, such excess being marked plus (+) or over, and such deficiency being marked minus (—) or under such average. These, being placed in special columns, are the variations from stride. It will be seen that the strides are far from being even measurements, but are subject rather to the condition of ground and to the various exertions of the mare when at speed. But in spite of variations the *stride of each leg must be the same or nearly so.* We cannot have a long stride in front and a short stride behind, or vice versa. Therefore, the error often committed by pen and tongue that the stride should be shortened either behind or in front by means of a certain style of shoeing is very misleading. What is really meant is the *shortening of forward extension.* I shall have occasion to touch upon that point again.

Now, I have found that in nearly all cases (and there were many) the total scope of variations indicates this:

(1) In *fore legs* the *greater total variation* belongs to or occurs in the *stronger leg;* and

(2) In the *hind legs* the *greater total variation* belongs to or occurs in the *weaker leg.*

By "total variation" is meant the entire scope of such + and — variations for the 20 strides, as the figures under the variations indicate. This is like adding same by arithmetic and disregarding the plus and minus signs, which latter are only to show the total extensions over and below the average stride. But if, furthermore, we divide the total variations as they stand by 20 we shall obtain the tendency of each stride with reference to the average stride.

For instance, we have as results of such division:

Fore		*Hind*	
near	off	near	off
+.69	+.85	+.85	+.91
—.79	—.90	—.78	—.76
—.10	—.05	+.07	+.15

and *adding* these averages by the *simple rule of algebra* as given on p. 66 we get the results as shown, which mean, briefly mentioned, that fore feet fall short of average a trifle and hind exceed it a little. And this again proves that there was momentarily an increase of speed during trial, as elsewhere noted, which is always caused by greater hind extension first.

And so even at this stage of the analysis of Lou Dillon's gait we can say that her off fore leg is the more active or stronger leg, and the near hind is the more regular or stronger leg than its opposite mate. Allusion has been made to the interrelation of the four legs, or the influence which one deficient leg may have on its opposite mate or on its diagonal companion with which it moves at the same time. The off fore in this case will pull along the near hind, or vice versa; and the lagging off hind may retard the extension of the near fore. It is therefore impossible to establish the tendencies of extensions by merely considering the stride and the variations.

Let us, therefore, consider the extension of each leg with reference to its opposite mate, as shown in table of Fig. 37.

These extensions are likewise figured from original measurements as given in Fig. 34, and they are found by deducting the figures of one foot from the next one. In the "fore" column we have, for instance, 19.30—9.70=9.60, this being the extension or distance of off fore to near fore. Then again we have the next distance from last near fore to off fore. Here the figures are 28.75—19.30=9.45 for the extension or distance from near fore to off fore. On the table the letters "o to n" and "n to o" indicate the distances from off to near and from near to off. With a little practice it is not much of a trick to figure this out rapidly.

Now, when 20 such distances or extensions from one foot to its

FIG. 37.

DISTANCES BETWEEN TWENTY OPPOSITE FORE AND HIND

(Near fore to off fore, etc.)

Average, 9.62 (2 × 9.62 = 19.24).

FORE			HIND	
Off to Near	*Near to Off*		*Off to Near*	*Near to Off*
9.60	9 45		10.05	9.30
9.30	9.50		9.70	9.20
9.90	9.50		9.90	9.20
9.45	9.75		10.15	9.15
9.35	9.95		9.90	9.50
9.30	9.45		9.35	9.45
9.80	9.45		10.	9.40
10.05	9.70		10.	9.20
9.35	9.80		9.90	9.50
9.55	9.70		9.60	9.50
9.55	9.60		9.65	9.50
9.70	9.60		9.90	9.65
9.55	9.55		9.70	9.55
9.75	9.55		9.80	9.45
9.75	9.75		9.95	9.45
9.55	9.65		9.80	9.55
9.65	9.90		9.80	9.80
9.70	9.80		9.95	9.50
9.55	9.50		9.65	9.35
9.35	9.80		9.75	9.40
191.75	192.95		196.50	188.60
9.587	9.647		9.825	9.43
	+ .06		+ .395	
Excess	$+\frac{.06}{2} = .03$		$+\frac{.395}{2} = .1975$	

opposite mate have been found and arranged in columns for each foot

we shall readily see the curious inequalities of such extensions, even in a horse of an apparently good gait. This proves in part my contention that only by an accurate method, such as this, can we detect the faults or peculiarities of a gait.

Adding these four columns and dividing by 20 we have the actual *average extension of each leg with reference to its opposite mate,* but this being the difference of two averages these fractions should be divided by 2 to ascertain the actual mean difference between the extensions of legs or feet. Hence off fore precedes near fore by 0.03 of a foot or 0.36 in. or 1/3 in. and near hind travels ahead of off hind 0.1975 of a foot or 2.37 inches or about 2 1/3 inches.

It will be noted that the averages of fore added together are 19.23 feet and those of hind are 19.25, which seems to indicate that for those 20 strides at least the hind exceed the fore slightly in extension. The same fact might have been noticed in Fig. 36; and it shows that hind legs were, in this stretch, slightly more active than the fore, an observation made in a good many resolute trotters with good hind action. But if we were to measure 100 strides this apparent greater extension of hind would subside at times and thus keep the horse from breaking. For, it should be remembered that the increase of stride is always first made by the hind legs; and, therefore, this activity of hind in this case must simply be due to increasing speed as she trotted over that piece of ground.

The general average of all of the four legs is, as indicated at head of table, 9.62 ft., which taken twice will give the general average of stride, or 19.24 ft., as we computed it in Fig. 36.

The result of the last table illustrates plainly the original method of David Roberge of reducing the analysis of gait to a series of "pointing." Here we have *pointing at speed,* which is still more expressive than "pointing" at rest. We have, therefore, arrived at the indications of irregularities of gait by means of pointing or extension. These extensions, when unequal, simply show the habit of a gait and furthermore indicate the solution of a possible correction. Later on it will be shown that Roberge's simple exposition of pointing will also serve as a suggestion for a remedy.

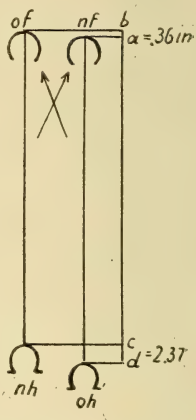
Another table in Fig. 38 is offered to further understand the

FIG. 38.

TWENTY DISTANCES OF CORRELATED OR DIAGONAL FEET
(Normally the same on both diagonals).
Average, 3.26.

Distance		*Distance*
3.65	nh	3.05
3.05	nf	2.85
3.55	oh	3.15
3.40	of	3.
3.20	nh	3.25
3.05	nf	3.15
3.50		2.95
3.60	oh	3.30
3.45	of	3.35
3.40		3.50
3.55	nh	3.50
3.70	nf	3.40
3.30		3.15
3.35	oh	3.10
3.40	of	3.20
3.30		3.15
3.25	nh	3.35
3.25	nf	3.10
3.15		3.
3.	oh	3.05
67.10	of	63.55
+ .17		3.18
.1975 — .03 = .1675	nh	
	nf	

FIG. 39.
Scale $\frac{1}{2}$ in to 1 foot



Dist nf - oh = 3.35 ft
Dist of - nh = 3.18 ft
Diff bet pairs = .17 ft
or 2.04 in
Average dist = 3.26 ft

$ad = ac + cd$
$bc = ac + ba$

$ad - bc = cd - ba = 2.01$ in.

movements of the trotter. It considers the distance between the

two correlated legs, that is, the two which move together, such as the near fore and off hind and the off fore and the near hind. It should be assumed as an axiom, or a proposition unnecessary to prove and sufficiently evident, that these distances must be the same in the square trot. For, to insure regularity of action in the trot as well as in the pace the distances of feet moving and landing on ground together cannot help being alike on both sides. If they were not the gait would approach single-footing.

These distances are computed by deducting the measurement of one hind foot from that of its correlated fore or the diagonal fore which moves with that hind. In Fig. 36 we have, for instance, o h = 15:65, to be taken from n f = 19.30 or 19.30 — 15.65 = 3.65 ft. Again, n h = 25.70 to be taken from o f = 28.75 or 28.75—25.70 = 3.05, and so on, always deducting the figure of one hind from that of its diagonal fore on the opposite side on the line below it.

There are, in consequence, two columns, and adding these we obtain, after dividing with 20 and getting the average on each side, a difference of 0.17 ft. or 2.04 inches between the sides. This means that the distance between near fore and off hind is 2.04 inches greater than the distance between the off fore and near hind. This is easy to prove by figures of previous table where it was shown that extension of off fore over near fore was 0.03 of a foot and that of near hind over off hind was 0.1975 of a foot. This would present the matter as in Fig. 39, though the difference here does not quite agree with difference found in Fig. 37, which showed it to be 0.1675 of a foot, or just 2 inches instead of 2.04 inches. It is not often that these calculations show a difference, but owing to the greater activity of hind, due to probable increase of speed during trial, such a small difference in averages is apt to arise.

There is one more consideration about these measurements which concerns the relations between fore and hind legs, and that is the so-called "overstep" or distance that hind foot is placed ahead of fore foot on each side. Such calculation is only of importance to find out the relative over-reach of hind and backward pointing of fore feet. With increase of speed the overstep increases in distance, for

the greater the speed the longer will be the flight through the air of the horse in motion; and this overstep shows in reality the distance between one set of legs moving together from that of the other set. Its average for both sides will prove again the faults of the gait as we shall see in Fig. 40. Here we calculate from table of Fig. 34 the overstep by crosswise subtraction, as, for instance, taking the measurement of each fore from that of each hind following it. Starting, as is always advisable, with overstep of first stride (19.30), we have 25.70 — 19.30 = 6.40 on near side, and 35. — 28.75 = 6.25 on off side, again dividing these oversteps into those of near side and those of off side until the 20 oversteps have been computed. Adding these again and dividing by 20 we get for each side the average overstep, or dividing the total by 40 we obtain the general average of 6.36 ft.

There appears again a difference between the two sides, which is the difference in extensions running through the whole trial, as shown in Fig. 41. Here we have the two oversteps placed side by side. We know that the extension of off hind over that of near hind is 0.1975 of a foot, hence cd = 0.1975 ft.; and also that extension of off fore over that of near fore, *i. e.*, a b=0.03 ft. Therefore the extension on near side must be greater than that of the off side by what the off hind foot lacks and the off fore foot gains. In other words, the two feet on off side approach each other by their opposite tendencies and the overstep loses as much on the off side as this approach measures, or ab + cd, which is 0.2275 ft. or 2.73 inches.

If in Figs. 41 and 39 I endeavor to prove the subject matter of table Fig. 40 by a few simple algebraic equations or signs it is not for the purpose of rendering this subject more abstruse but rather to satisfy the usual demands of simple mathematics for a proper "Q.E.D." — or "which was to be proved."

Since Lou Dillon had the peculiarity of crossing over her fore legs, the overstep is not so clearly distinguishable on the ground as it is with the trotters that have not got that way of going. In Fig. 41-A we see the ordinary form of locomotion, from which the overstep can

be easily ascertained for each side, the off fore being in line with the off hind and the near fore in line with the near hind.

FIG. 40.

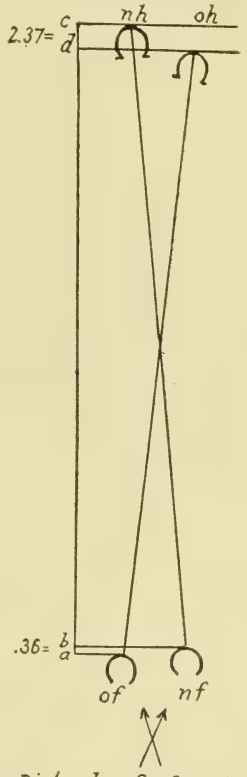
TWENTY OVERSTEPS OF HIND OVER FORE.

Average, 6.36.

NEAR SIDE		OFF SIDE
Distance		*Distance*
6.40	nh	6.25
6.65	nf	6.35
6.35	oh	6.05
6.75	of	6.15
6.70	nh	6.25
6.30	nf	6.30
6.50	oh	6.45
6.40	of	5.90
6.45	nh	6.15
6.20	nf	6.
6.10	oh	6.
6.20	of	6.25
6.40	nh	6.40
6.45	nf	6.35
6.55	oh	6.25
6.50	of	6.40
6.55	nh	6.45
6.70	nf	6.40
6.50	oh	6.35
6.75	of	6.35
129.40		125.05
6.47		6.25
+ .22	nh	
.1975 + .03 = .2275	nf	

FIG. 41

Scale ½ in. to 1 foot.



Dist nh - nf = 6.47 ft.
Dist. oh - of = 6.25 ft.
Diff. bet oversteps = .22 ft.
or 2.64 in.

Average overstep = 6.36 ft

$ac = ad + dc$

$ab = ad - ba$

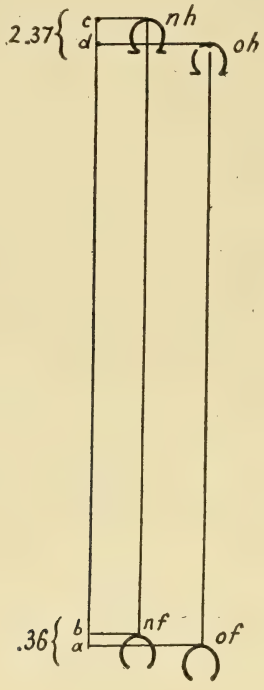
$ac - ab = dc + ba$

or 2.73 in.

In considering the overstep we should remember that its distance is in a certain proportion to the general average of stride, and that the greater the stride, the greater will be the overstep. Practice will determine its proper proportion to the stride.

It may be stated here that with horses of hind legs pointing forward or standing under excessively, or with fore legs pointing backward, or both fore and hind pointing in that manner, the overstep will

FIG. 41A



show an unnatural length even with a short stride. In other words, though this calculation of overstep is not absolutely necessary for practical purposes, it gives an insight into the locomotion of the trotter that makes it clearer to the mind in what way a possible correction may be attained. I do not insist on a complete carrying out of these calculations of the measurements, because for practical purposes it *may* suffice to ascertain simply the average stride, the distances of correlated feet of Fig. 38, and the extensions of legs as given in table of Fig. 37. If

the total work of such an investigation, therefore, seems too much for some trainers or owners to bother with, the above requirements are absolutely necessary for any comprehension of the subject's gait. As mentioned before, horses are apt to trot with one foot ahead of the other in front, but such a habit should call for a like difference in extension of its correlated hind foot or that hind foot which moves with that fore. An analysis of the gait would readily prove this fact.

So in this case of Lou Dillon's, if the off hind had only lagged, say, one inch, and the corresponding near fore had also lagged one inch, we could pronounce such a gait as a perfect trot, because the most important condition of such a perfect gait would have been fulfilled.

This condition remains a peremptory demand for such a perfect trot and calls for an equality of distance between the diagonally moving feet. Wherever these distances, as given in table of Fig. 38, are not equal we must look for the offending leg and try the probable remedy on the same. All so-called "rough" gaits or single-footing or breaks are due to some over-activity of one leg and sluggishness of another, thus causing the inequality of the distances between the two pair of correlated feet, and in establishing such defect we find the probable cause of disturbance upon which to base a change in the paring of the foot or the shoeing of the same. Examples in a later chapter will make this more clear.

In the computation of the previous tables it has been shown that in order to establish a correct agreement of one with the other the first two measurements from one fore to one hind should be neglected and the start should be made with the measurement containing the record of the stride. For instance, the measurement from near fore to near hind is in table Fig. 34 = 6.40, which is not considered in any figuring, but the start is made from the two horizontal figures containing the first stride measurement. In these oversteps we therefore not only neglect 6.40, but also the second line, and proceed only with third line containing the first stride: 19.30 or 25.70 — 19.30 = 6.40. This method has been found to conform to all proofs or verifications; for, since we start with the first full stride, the start of all other relations should be made with reference to that first stride.

To make this investigation complete it is necessary to find the actual positions of the tracks on the ground. This manner of placing the feet on the ground or of handling the legs while in motion may be termed *lateral extension.* We have just considered the extension of the horse as far as its forward and backward motion is concerned. Now we must face the question of the line trot and its variations to inside and outside. The examination of the impressions on the ground is important and should be studied even if for lack of time or interest no further measurements are taken. For, the manner of position or placing indicates the line or curve of motion in which the particular foot travels. *In the even, regular and energetic gait, whether it be the trot or the pace, the tracks on the ground should record a firm and clear, and, therefore, brief and light, contact without slipping or sliding.* The foot lands squarely and stays where it is put until ready for the supreme effort of propulsion. Then it leaves the ground as quickly and without slip or slide, the impression showing no special effort or strain. This is really a great characteristic of proper "balance" and the tracks on the ground should be systematically examined so as to enable the intelligent trainer or shoer to judge the shortcomings and requirements of the gait.

In order to clearly understand the relative positions of such tracks we must have some standard line by which we can judge. It suggested itself to me that a line described on ground by the vertical plane bisecting the animal lengthwise would be that standard line. In other words, if we lengthen down to ground the upright plane containing the center of gravity we shall have a line on both sides of which the tracks should be found at equal distances from it. For practical purposes we may assume this line to run midway between the tracks of the sulky wheels. *This line I prefer to call the "median line;"* and it should be drawn by means of a carpenter's or mason's white cord along the straightest part of the trial to be investigated. Finding, for instance, the width of sulky wheels to be 4 feet 5 inches, this line should be staked out with surveyor's pins every 6 to 10 feet and put 2 feet 2½ inches from the center of either wheel track.

A slight curve may be followed in line as it exists in wheel tracks and for practical purposes such a curve does not affect the results seriously, especially if another slight curve in the opposite direction is included in that stretch to be measured. Of course, it always is very desirable that in every trial made the horse should be driven as straight as possible. This cannot always be done and we must be satisfied with a good average showing.

In Fig. 42 will be seen the main features of a cross section of a horse in motion hitched to a sulky. AB is the ground surface and comprises the width of sulky gauge; the circle above is the body of the horse with center of gravity at C; GH and DE are perpendicular lines indicating the moving legs of said horse; and MN is the vertical plane

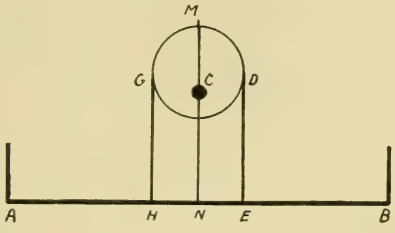


FIG 42

parallel with the lines described by A and B, and bisecting or cutting in half said moving horse. Judging from the mechanical accuracy of construction of the sulky, we may safely assume that the horse travels on lines equally distant from the tracks left by the wheels A and B, and that the median plane MN strikes the ground at a point N midway between A and B. Therefore, for all practical purposes the averages of the distances of the tracks at E and H should be equally distant from N, the median line drawn on ground as suggested.

These reasonable assumptions or postulates are offered to establish a standard gait and a standard balance, for by such a standard we must judge the deficiencies.

After a trial over a prepared piece of ground and after the white cord has been staked out as the median line between the tracks of the

sulky wheels, we shall have the presentation of lines and points in question, as shown in Fig. 43.

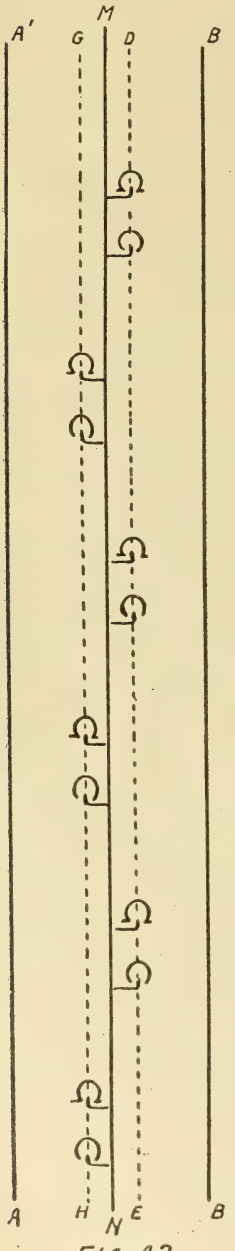


FIG. 43

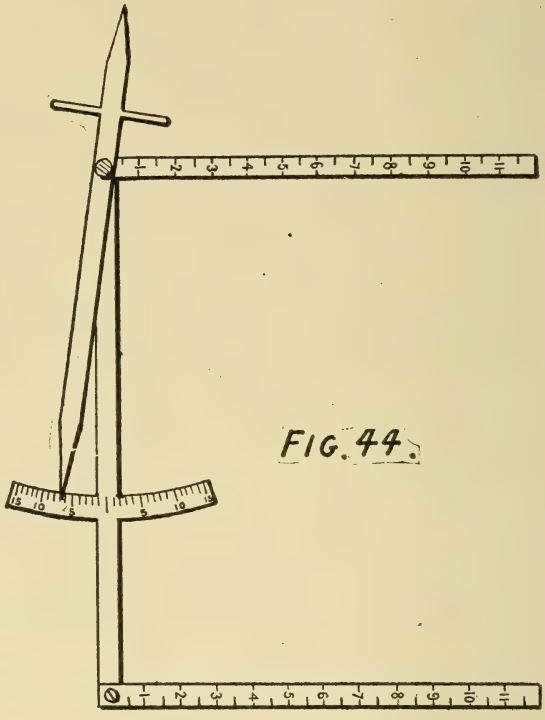


FIG. 44.

In order to find the correct positions of the four feet with reference to this median line MN, I devised an instrument, the picture of which appears in Fig. 44. This track guage can be easily applied to each impression on ground, and will give both distances of each foot from median line and direction or pointing of each foot as well.

The distance of each foot from median line should be measured from the frog or from a point midway between the heels of the shoe as it appears on ground. Then we shall have a correct indication of the pointing of the toe

either in or out. Any toeing in should be designated as minus (—), and any pointing out as plus (+); and any crossing over the median line by either near or off feet should be designated by minus (—). The

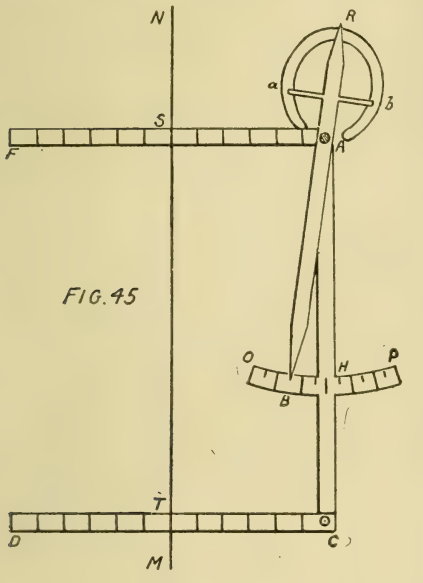
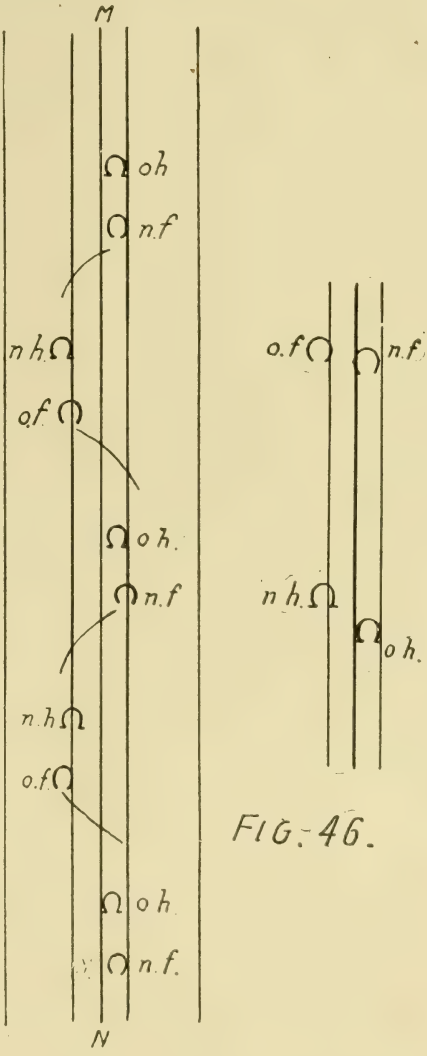


FIG. 45.

B R—Indicator pivoting at A.
R—Point of toe.
a b—Crosspiece at right angles to B R and extending to quarters.
A—Thumb-screw with sharp point underneath midway between heels of shoe.
A B—Radius of arc O P, giving angle of A R with A C (parallel with M N).
M N—Median line.
A F, C D—Pivoting at C and A measure equal distances from M N at right angles.



feet therefore remain plus or over in distances from median line as long as they remain on the side where they are supposed to belong; and they change to minus when they cross over to the opposite side. Such a notation facilitates finding the averages for all four feet both

in distance and in direction. Again, it must be emphasized that the averages obtained in all these calculations indicates the animal's habitual or compulsory mode of motion under the conditions of such a trial.

Fig. 45 will show the track gauge applied to a track of a shoe, which might indicate an angle outward or plus (+) of about 15 degrees, and a distance for off fore of about 6 inches or more. If this track, however, were that of the near fore it would not only show that the near fore leg crosses over, but also that the more natural toeing *out* has given way to a marked toeing *in*; or, in other words, the near fore would show a distance of —6 and a direction or angularity of toe of —15 degrees.

Perhaps it is just as well to illustrate all this by the actual plotting or fixing of Lou Dillon's tracks. I offer here, in Fig. 46, an explanatory drawing of the tracks in part as found, and along side a presentation of the fore feet as they averaged in their lines of motion and direction. When first seen these tracks looked like those of a pacer, and, judged from the standpoint of a standard gait, this mare cannot pass muster. But she is a study of compensations; that is, of such motions of legs and feet as will prevent or make improbable any interference of hind with fore feet. This peculiarity of gait can be seen in Fig. 35, where the mare is at full speed. The off fore is coming from the near side and the off hind is seen on outside of off fore, and no interference seems possible between the legs on the same side.

Another table is offered to the reader's attention in Fig. 47, where again the various measurements made with the track gauge for 19 strides are arranged according to fore and hind and near and off sides, and the distances and angles of directions are found in columns for calculating the averages. The distances (D) are given in inches and decimal fractions thereof. The small letters "t" and "oh" or "ih" stand for concussions or slips at toe (t), outside heel (oh) or inside heel (ih); and sometimes "hh" appears, which stands for both heels. A line under any of these notations, such as t, oh, ih, hh, means an intensified impression caused by undue concussion or by slipping. It is well to note these features of the tracks and take an average of

them; for, repetitions of any such marks on ground indicate in part the faults and peculiarities of gait. Every observation adds its mite to the sum total and completes the final verdict.

For the proper understanding of this table a trotter with a straighter direction of feet would have been better here, but the reader

FIG. 47.

DISTANCES FROM MEDIAN LINE (TO MIDDLE OF FROG) AND ANGLES WITH SAME + AND —

FORE				HIND			
Near		*Off*		*Near*		*Off*	
D	*Angle*	*D*	*Angle*	*D*	*Angle*	*D*	*Angle*
— 1.50	+ 1°	— 6.	+ 1°	+ 4.	+ 4°	— .25	+ 4°
— 2.50	0	— 5.50	3	6.25	3	1.	6 oh
— 1.	0	— 4.	3	3.	6 t	1.	6 t
— 1.50	— 2	— 5.	— 1	4.	4 t	.25	9 t,oh
— .50	— 4	— 4.75	2	4.75	5 t	.75	8 oh
— 1.50	— 5	— 3.	3	3.25	5 t	2.	9 oh
— 3.	2	— 3.25	— 4	3.	7 t	1.25	10 oh
— 2.75	— 2	— 3.75	2	4.25	6 t	— .25	9 oh
— .50	— 3	— 6.25	4	4.75	6 t	0	8 t,oh
0	3	— 5.	5	4.75	5 t	1.25	10 oh
— 1.25	— 1	— 4.50	2	3.50	5 t	2.	9 oh
— 2.25	— 1	— 3.	— 2	4.	3 t	1.50	7 oh
— 2.50	— 4	— 4.	3	4.50	4 t	0	8 oh
— .50	— 4	— 5.50	3	4.50	6 t	0	9 oh
— 1.	— 4	— 5.	0	— 5.	5 t	— .50	8 oh
— 1.	— 3	— 5.	3	5.	6 t	0	6 t
— 1.50	— 4	— 3.50	3	3.50	5 t	1.	6 oh
— 2.75	— 5	— 2.50	1	3.	7 t	2.50	9 oh
— 3.	— 3	— 3.	— 3	3.50	6 t	0	7 oh
— 30.50	+ 6°	— 82.50	+ 37°	+78.50	+98°	+14.50	+148°
	— 45		— 10			— 1.	
— 30.50	— 39	— 82.50	+ 27	+78.50	+98	+13.50	148
— 1.6	— 2°	— 4.34	+ 1.4°	+ 4.13	+5.16°	+ .71	+ 7.8°
	0		0		t		oh
	break over slightly on outside toes				toe		outside heel

will no doubt follow the explanations readily. It is necessary to resort to a little algebra regarding the plus and minus signs and the finding of averages, but I trust that this will not deter anyone from studying this table. The meaning of the + and — signs has already been explained and in popular language it might be said that whenever the foot goes in an unnatural direction, that is, when it crosses over the

median line or toes in, the minus (—) sign indicates that tendency The plus (+) sign is used merely, therefore, as indicating a more or less correct position of foot on ground and is generally understood where not given. In adding the plus and the minus quantities or numerals separately, we are able to get at the sum total so that we may get from it the average by dividing with the number of strides or notations registered. It may be well to introduce a definition or corollary of algebra here to understand the meaning of sum total. It reads as follows:

"The sum of two quantities, the one positive and the other negative, is the *numerical difference,* with the sign of the greater prefixed."

If therefore the distance (D) of off hind, as found in table, shows a variation from 0 to—.50 or ½ inch on left side of middle line, and from 0 to 2.50 or 2½ inches on its right side, we find by adding the variations on right side (or plus) (+ 14.50), and also those of left side (—1), the difference of which is +13.50, which divided by 19 will give us the average, or +.71 inch, or nearly ¾ inch on right side of middle line. It will appear that this leg moves in a closer position as compared with near hind, which shows a more positive variation throughout and averages 4.13 inches to left of middle line.

The pointing in and out of foot as registered by the angles found with the track gauge will further illustrate the above definition of sum total. In second column we have +6—45, which shows a difference of —39; which for 19 strides averages —1.6°. In the fourth column we see the off fore point out or toe out a total of +37° and point in or toe in a total of —10°; the sum total of which is therefore +27°, which, divided by 19, or total occurrences, gives us +1.4°. This means that off fore, in spite of crossing over to near side 4.34 inches beyond middle line, still *toed out,* or to right, just a little, while the near fore crossing over to off side 1.60 inches on right side of and beyond middle line *toed in,* or to right, a little more.

The hind feet, having no such crossing over motion, are more easy to understand in their directions. It is plain addition of columns and divisions by 19 occurrences. We can see readily that off hind is being more or less dragged along, twisting to a greater angle (7.80°) and

being planted down close to the middle line (+.71 in.), while the near

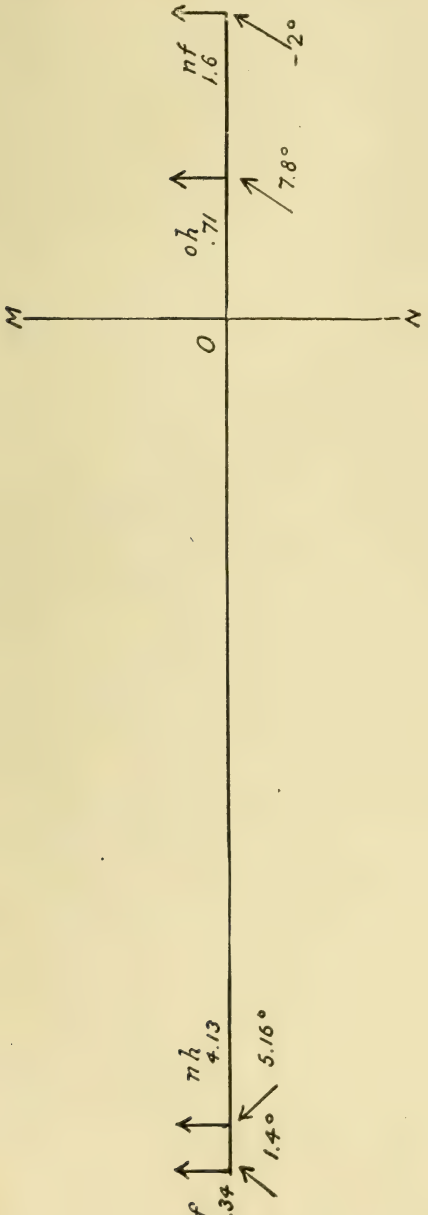


FIG. 48

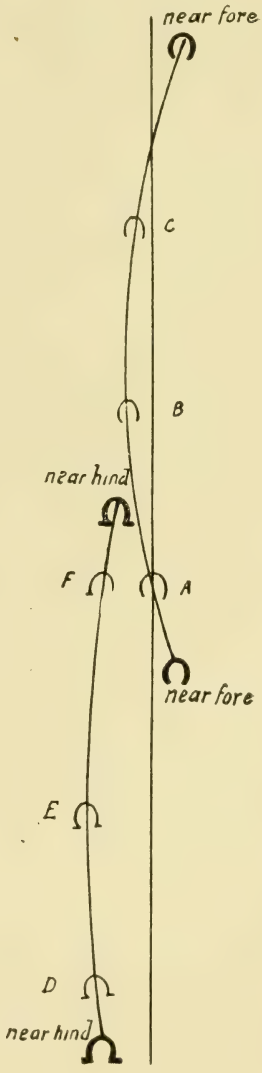


FIG. 49.

hind goes far out (4.13 in.) and preserves a much more reasonable toeing out (5.16°).

In Fig. 48 is given a section of actual distances and positions of feet according to the averages found. The hind feet are respectively 4.13 in. (n h) and 0.71 in. (o h) from the median line M N at O. Having found the average distances of fore to be negative quantities, we know that such distances from median line are on opposite sides, or —4.34 in. for off and —1.60 in. for near fore. The mare proves to be a line trotter of an inverted order, hind feet apparently following their diagonal mates, but is by no means a real line trotter and is, moreover, a trotter of a wide and open gait.

Regarding the observations of break-over, or slide or concussion, the fore show a slight break-over at outside toe, hardly worth noting on table; but the hind show that compensating activity which two legs, unequal in extension, generally manifest. It will be noted that while off hind strikes outside heel and has hardly any mark at toe, the near hind shows the extra effort at toe, which marks propulsion of a greater degree. We therefore note that near hind makes an extra effort to carry along the off hind, which, by some reason or other, fails to extend forward sufficiently and shows no effort of propulsion at toe.

Lou Dillon in gait was a freak, for without that crossing over to the extent of nearly 6 inches of space between the fore (from frog to frog) and the slight outward action and reach of hind feet, she could not have cleared her feet as remarkably as she did. Let me illustrate this by Fig. 49, where the feet are represented as found on ground. These are the feet of one (near) side, which in the trotter move always against and away from each other. (See Fig. 22, etc.) It is the same on off side, of course. Now, there is a moment when these feet of the same side are either as close together as possible or cross each other, as in speedy cutting, according to conformation and gait. In this instance, however, such or any interference seems almost impossible, or rather improbable, because of the directions of those fore and hind feet on each side.

Fig. 49 shows such possible interference at F—A after near fore just left its track (dark print) and near hind is just about to land on

ground (dark print) beyond it. Whatever the position of F and A during the moment of their nearest approach (or passing), in this particular case the danger point is avoided by the crossing over of fore feet. This latter direction is the peculiar compensation for a powerful action behind and without which the ordinary straight extension of fore might have proved an obstacle to extreme speed. The fact of her record remains as an indication of such a clear gait. We cannot quite accept it as a standard, though there can be no doubt that the action of the fore legs looked at from the side as shown in the plates of Figs. 22 to 25, emphasized the necessity of a powerful hind action coupled with less clawing of the air by the fore than many a fast trotter shows.

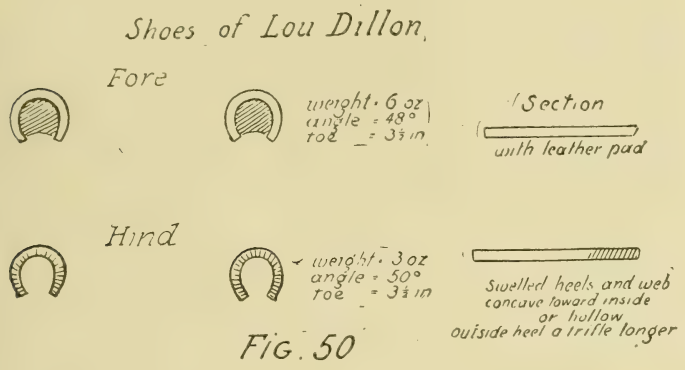


FIG. 50

Under the field glass inspection it was a revelation to see that decisive and high hind action with its wonderfully divided backward and forward extension, as well as the direct and straight extension and the quick forward reach in front which showed no wasted knee folding Therefore, in advocating a nearer approach of elevation of hind and front action as a help to proper balance and absence of interference, this mare can well serve as a standard to judge by. There can not be imagined greater harmony of motion between fore and hind as she presented it in that trial. The shoeing of this mare was simple, as seen in Fig. 50, to which reference will be made later.

More than two years ago publication was made against my wish of the results of above trial and slight errors then made in the presentation of the case have been carefully corrected now.

From the review of the trotting gait we shall now pass on to a similar investigation of the pacing gait. Fig. 51 presents the picture of the then 5-year old bay mare Alone, 2:09¼, owned by T. W. Barstow, her breeder, of San Jose, Cal. She is by Nearest, 2:22¼, full brother to John A. McKerron, 2:04½, both being by Nutwood Wilkes, 2:16½. Some years ago, this trial was made through the courtesy of Mr. Barstow, and for a subject of illustrating the pace none more perfect could have been selected. Unlike Lou Dillon, Alone is a mare 16.1 hands tall and of magnificent proportions, a powerful and serviceable animal and of a smooth, low gait. During the trial she paced a 2:05 gait; and she has a half mile record of 59½ seconds. Like Lou Dillon, she required practically no boots except for protection at dangerous points. A small heel boot in front and ankle boot behind was her entire outfit.

Unfortunately only 15 strides could be obtained instead of the customary 20, which always necessitates more calculations than a decimal like 10 or 20 does.

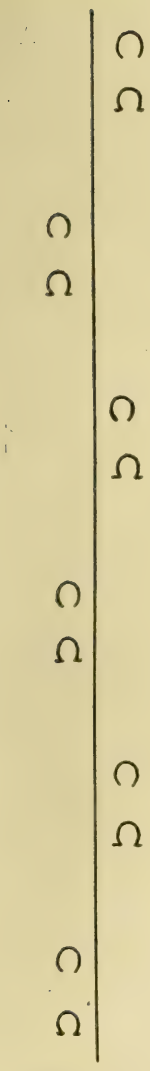
In Fig. 52 is given the appearance of the tracks of the pace. While in the trot the movement of the feet on each side is in opposite directions and results in the overstep of hind over fore, as seen in Figs. 40 and 41, in the pace the hind follow their anterior members on the same side. Hence, in measurements as well as in tables the columns for hind feet precede those for fore feet.

Sticking the pin that holds the end ring of tape line into the ground at *toe* of near hind, we again measure off 100 feet and in a similar note book properly lined with pencil into columns for measurements we enter the feet and decimals thereof as they appear at toe of each foot, taking care to alternate sides in book as they alternate on ground; that is, in pairs of hind foot and fore foot.

Fig. 53 presents the results of such measurements of the mare Alone. By subtracting alternate lines from each other we obtain again the strides for hind and fore, the near side being designated by the letter "n" and the off side by the letter "o."

As in the analysis of the trot, we have again three relative dis-

FIG 51.



Tracks of the pace
FIG. 52.

FIG. 53.

MEASUREMENT OF TRACKS IN FEET AND TENTHS OF A FOOT (FROM TOE TO TOE).

Continuous Measurements starting with Near Hind.

		Hind	*Stride*	*Fore*	*Stride*
N	Toe >——>	—	5.25	—
O	9.55	—	15.05	—
N	19.15	19.15	24.00	18.75
O	28.90	19.35	34.00	18.95
N	38.45	19.30	43.60	19.60
O	48.45	19.55	53.35	19.35
N	57.75	19.30	62.90	19.30
O	67.75	19.30	73.10	19.75
N	77.45	19.70	82.45	19.55
O	87.20	19.45	92.20	19.10
N	97.00	19.55	102.45	20.00
O	107.10	19.90	111.90	19.70
N	116.40	19.40	121.50	19.05
O	126.65	19.55	131.75	19.85
N	136.20	19.80	141.15	19.65
O	146.15	19.50	151.05	19.30
N	155.60	19.70	161.05	19.90
O	166.05	19.90	170.80	19.75
N	175.55	19.65	180.60	19.55
O	185.90	19.85	190.95	20.15
N	195.45	19.90	200.40	19.80
O	205.50	19.60	210.65	19.70
N	215.55	20.10	220.95	20.55
O	225.85	20.35	230.65	20.00
N	235.25	19.70	240.40	19.55
O	245.90	20.05	251.05	20.40
N	255.50	20.25	260.45	20.05
O	265.70	19.80	270.65	19.60
N	275.55	20.05	280.55	20.10
O	285.90	20.20	290.80	20.25
N	296.10	20.55	300.70	20.15
O	305.45	19.55	310.65	19.85

N, near side; O, off side.

tances between the feet which will establish the peculiarities of such measurements, to wit:

(1) The distance between each pair of correlated feet or the pair that move laterally together;

(2) The extension or distance of one foot to the other; that is,

the distance from near to off and from off to near (both fore and hind);

(3) The distance between each pair or correlated feet moving together; that is, the distance between the double and full near extension and the double and full off extension.

To roughly calculate the average of the 15 strides we take last near hind measurement and divide same by 15, or 296.10/15 = 19.77 ft. As in the trot this result is not reliable, but will serve as a quick estimate of the length of the average stride. The exact average will appear in next table of fig. 54.

FIG. 54.

TWENTY STRIDES AND VARIATIONS FROM AVERAGE (+ AND —).

Average, 19.72.

HIND				FORE			
Near	*Var.*	*Off*	*Var.*	*Near.*	*Var.*	*Off*	*Var.*
19.15	— .57	19.35	— .37	18.75	— .97	18.95	— .77
19.30	— .42	19.55	— .17	19.60	— .12	19.35	— .37
19.30	— .42	19.30	— .42	19.30	— .42	19.75	+ .03
19.70	— .02	19.45	— .27	19.55	— .17	19.10	— .62
19.55	— .17	19.90	+ .18	20.—	+ .28	19.70	— .02
19.40	— .32	19.55	— .17	19.05	— .67	19.85	+ .13
19.80	+ .08	19.50	— .22	19.65	— .07	19.30	— .42
19 70	— .02	19.90	+ .18	19 90	+ .18	19.75	+ .03
19 65	— .07	19.85	+ .13	19 55	— .17	20.15	+ .43
19.90	+ .18	19.60	— .12	19 80	+ .08	19 70	— .02
20.10	+ .38	20 35	+ .63	20.55	+ .83	20.00	+ .28
19.70	— .02	20.05	+ .33	19.55	— .17	20.40	+ .68
20.25	+ .53	19.80	+ .08	20 05	+ .33	19.60	— .12
20.05	+ .33	20.20	+ .48	20 10	+ .38	20.25	+ .53
20.55	+ .83	19.55	— .17	20.15	+ .43	19.85	+ .13
296.10		295.90		295.55		295 70	
			STRIDES				
19 74		19.726		19 70		19.71	
			TOTAL VARIATIONS				
+	2 33	2 01		+	2 51	2.24	
—	2.03	1.91		—	2.76	2.34	
	4.36	3.92			5.27	4.58	

Fig. 54 will show the strides of each foot as it varies from the general average, the latter being accurately 19.72 ft. This is again found by dividing total footing or 1183.25 by 15. Comparing each stride with this average, we have again the variations of a greater or a

smaller stride from that average of 19.72. Entering in the variation columns the difference between the actual stride and the average, we designate that difference with plus (+) when the stride is greater than average, and by minus (—) when the stride falls short of average. Again, we see long and short strides throughout the movements of the legs, but they must all conform to this general average if the gait is to be kept up as a pace. So again, in spite of variations, *the stride of each leg must be the same or very nearly so.* We can not have a long stride in front and a short stride behind, or vice versa; but we may find greater variations in one leg than in another, or in the hind than in the fore, or vice versa.

This trial was not made over an ideal piece of ground, the same being on *outside* of homestretch near grandstand and in rather loose soil. Moreover, the mare swerved a little to left, being used to going on inner side. Hence, the near fore shows a little greater variation, that being the side to which she tried to get.

From experiments we have the same rules as to the indications of variations as were set forth in the case of Lou Dillon, namely:

(1) In *fore legs* the *greater total variation* belongs to, or occurs in, the *stronger leg;* and

(2) In the *hind legs* the *greater total variation* belongs to, or occurs in, the *weaker leg.*

By "total variation" is meant the entire scope of such + and — variations for those 15 strides; as the figures under the variations indicate. This is simply an ordinary addition without regard to the plus and minus signs, which latter only show the total extension over and below the average stride. But if, furthermore, we divide the total variations by 15 we will obtain the tendency of each stride with reference to average stride.

For instance, we have approximately:

Hind		Fore	
Near	Off	Near	Off
+.155	+.134	+.167	+.149
—.135	—.127	—.184	—.156
+.02	+.007	—.017	—.007

and adding these averages by the simple rule of algebra, heretofore given, we get the results shown in footings, which mean, briefly stated, that hind feet exceed average slightly as compared with fore feet. This seems to prove again that there was momentarily an increase of speed during trial, which is always caused first by slightly greater hind extension.

Right here I beg to say a few words to the reader who may have found these minute details rather difficult or too abstruse for practical purposes. I simply desire now to demonstrate my investigation as fully as is possible for me to do, but will also assure the reader that for practical purposes there will appear in Chapter X only the main and most important features of such measurements, from which may be got a tolerably fair, if not thorough, understanding of the subject's gait.

We can now consider the extension of each leg or foot with reference to its opposite mate as shown in table Fig. 55. We must remember that in order to establish a conformity of results we should start with calculations of measurements from off to near side on the third line of table Fig. 53, using the first three figures only with reference to the line showing the first stride. In Fig. 55 there are given the extensions, as measured from one hind to the other and from one fore to the other, as follows:

19.15 — 9.55 = 9.60, 28.90 — 19.15 = 9.75, etc.; and 24 — 15.05 = 8.95, 34 — 24 = 10, etc., to the end. (See Fig. 53.)

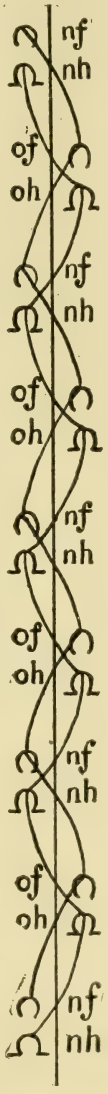
Adding the four columns thus found and dividing each result by the number of strides, or 15, we obtain the *average of extension of each leg with reference to its opposite member or mate.* There is a difference of extension between the hind of 0.44 ft. and between the fore of 0.34 ft., but these differences must be divided by 2, being the differences of two averages, in order to ascertain the actual mean difference between the extension of hind and fore.

Hence we find that off hind precedes near hind by 0.22 ft., or 0.22 × 12 = 2.64 inches, and that off fore precedes near fore by 0.17, or 0.17 × 12 = 2.04 inches. This shows in all a greater extension for the whole off side and illustrates my previous remark about the prefer-

ence some horses have for one side or the other, and that if such

FIG. 55.
TWENTY DISTANCES BETWEEN OPPOSITE HIND AND FORE
(Near hind to off hind, etc.)
Average, 9.86 (2 × 9.86 = 19.72)

HIND			FORE	
Off to Near	*Near to Off*		*Off to Near*	*Near to Off*
9.60	9.75		8.95	10.
9.55	10.		9.60	9.75
9.30	10.		9.55	10.20
9.70	9.75		9.35	9.75
9.80	10.10		10.25	9.45
9.30	10.25		9.60	10.25
9.55	9.95		9.40	9.90
9.75	10.15		10.	9.75
9.50	10.35		9.80	10.35
9.55	10.05		9.45	10.25
10.05	10.30		10.30	9.70
9.40	10.65		9.75	10.65
9 60	10.20		9.40	10.20
9.85	10.35		9.90	10.25
10.20	9.35		9.90	9.95
144.70	151.20		145.20	150.40
9 64	10.08		9.68	10.02
	+ .44			+ .34
Excess	$\frac{.44}{2} = .22$		Excess	$\frac{.34}{2} = .17$



difference of extension be uniform in the correlated feet, or those that move together, and if it be not excessive (both of which con-

ditions we find in this case), such small irregularities do not affect the harmony of motion to any extent.

It will be noted that the sum total of hind averages in this table (19.72) exceeds that of the fore averages (19.70), which same fact we notice in table Fig. 54. This illustrates the supposition that the mare was slightly increasing her speed during those 15 strides

In the language of David Roberge, there is a marked "pointing" on the off side of the table of Fig. 55. The mean difference between the extension of the off hind and that of the off fore is but 0.05 ft. or 0.6 inch, which appears as the difference between the distances of the correlated feet in the next figure.

In Fig. 56 we have again the calculations from table of Fig. 53 by means of crosswise subtraction in order to obtain the distances of the hind foot to the fore foot on either side. We start where the first stride occurs, that is, on the third line or the near side, as follows: 24 — 19.15 = 4.85, 34 — 28.90 = 5.10, and so forth for the 15 strides.

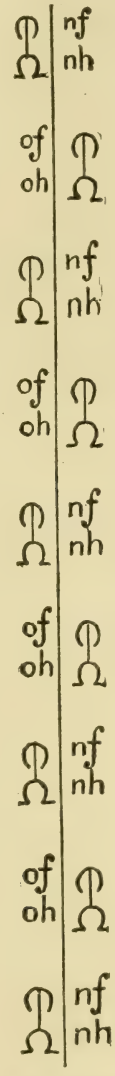
The addition of the columns in Fig. 56 and the division of the totals by 15, as seen on the table, will result in a difference of 0.05 ft. which means that the distance between the lateral feet on the near side is that much greater, or exceeds the distance between them on the off side by 0.6 inch. Although such a difference is an indication of a slight irregularity of gait, it is so small that it may safely be considered as being negligible. It should be remembered, however, that differences in averages, be they ever so small, point without error to some lack of harmony of motion in the mechanism of the horse.

There is, as in the trot so also in the pace, another point of view to be taken of the movements of the feet, namely, the difference, if any, of *extension of one pair of feet from the other pair of feet.* That is to say, if we take the lateral pair on the near side as a moving unit and the lateral pair on the off side as a unit, the distance between them as they are alternately thrust forward would appear to be the same. It is reasonable to suppose that such distances are the same, because on such equal extensions of one side to the other depends, more or less, the regularity and purity of the gait. In the trot these distances were

designated as the "oversteps," because on the ground the hind foot

FIG. 56.

DISTANCES OF CORRELATED OR LATERAL FEET (normally same on both sides)
Average, 5.03.



Distance	*Distance*
4.85	5.10
5.15	4 90
5.15	5.35
5.	5.
5.45	4.80
5.10	5.10
4.95	4.90
5.15	4.75
5.05	5.05
4.95	5.15
5.40	4.80
5.15	5.15
4.95	4.95
5.	4.90
4.60	5.20
75.50	75.10
5.06	5.01
+ .05	

Fig. 55 : .22 — .17 = .05

overstepped the fore foot on the same side. Now, in the pace this distance between these pairs of feet is found between fore and hind of

opposite side, as shown in Fig. 58. These distances are easily computed by subtracting each hind foot measurement from that of opposite fore on line below, as seen on table of Fig. 53. For instance, starting on second line and taking *off fore* or 15.05 from *near hind* or 19.15, we have 4.10 for the distance from *off pair* to *near pair* of correlated feet. Again, continuing from next *near fore* to *off hind,* we have 28.90 — 24 = 4.90, or the distance from near pair to off pair of correlated feet. After placing these differences in the columns as explained in table of Fig. 58, we again proceed to add the 15 records and divide by 15 to obtain the average of each side and by 30 to get the general average of 4.82.

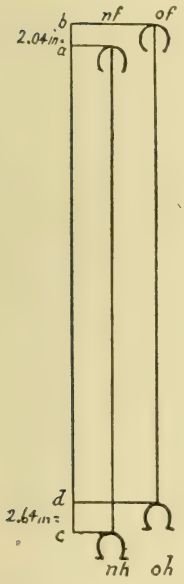
Again, we obtain the same proof of extensions and find that whole off side extension is greater than that of near side by 0.39 or 0.40 ft., or about 4.68 inches. In Figs. 57 and 59 a few simple methods of geometry and algebra have been employed to illustrate the subject in question and to satisfy the demands of simple mathematics, besides measurements, for a proper proof.

To this investigation of Alone's gait I may add a few remarks regarding her action and manner of going. She had good feet and was shod as given in Fig. 60. She was driven a very fast clip, better than her record gait. Having a low action, one could not realize her speed. Her tracks were firm and light, and without absolutely any indication of slipping or sliding or concussion. For a large mare (16.1 hands — 1200 lbs.) her motion was remarkably rapid and smooth.

The distance from one side to the other (4.82), or the "overstep" of the trot, was comparatively short for the speed she was going at and argues for rapid movements of limbs. Comparing this distance with distance of lateral feet (5.03) shows that she had length in proportion to her size. Her stride (19.72) was certainly good for her quick motion and low action. As compared with Lou Dillon, there was less of that tremendous reach of hind legs and less pointing back of fore legs, both of which accounts for the greater overstep (6.36) and closer distance of correlated feet or pairs of diagonal feet (3.26) in Lou Dillon's gait. But for that preference to off side, Alone's

gait is a better example of regular motion combined with high speed than Lou Dillon's gait was at that time after her greatest days.

FIG. 57.



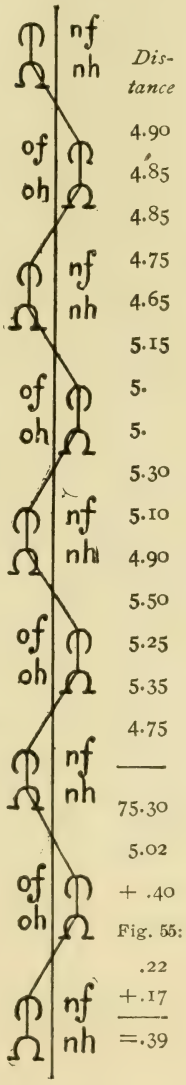
Dist. nh - nf = 5.06 ft.
Dist. oh - of = 5.01 ft.
Diff. bet pairs = .05 ft.
or .6 in.

Average dist = 5.03 ft.

$ac = ad + dc$
$bd = ad + ab$
$ac - bd = dc - ab = .6$ in

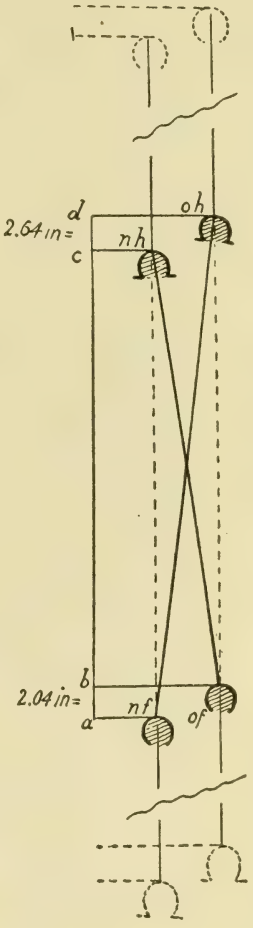
FIG. 58.

20 distances between opposite pair of feet from one side to the other. Average, 4.82.



Distance		*Distance*
4.10	nf nh	4.90
4.45	of oh	4.85
4.40		4.85
4.35	nf nh	4.75
4.80		4.65
4.50		5.15
4.45	of oh	5.
4.85		5.
4.75		5.30
4.50	nf nh	5.10
4.90		4.90
4.60		5.50
4.45	of oh	5.25
4.90		5.35
5.30		4.75
69.30	nf nh	75.30
4.62		5.02
	of oh	+ .40
		Fig. 55: .22
	nf nh	+.17
		=.39

FIG. 59.



Dist. nf - oh = 5.02 ft
Dist. of - nh = 4.62 ft
Diff bet opp pairs = .40 ft
or 4.8 in

$ad = ab + bd$
$bc = bd - dc$

$ad - bc = ab + dc = .39$ ft
or 4.68 in

In both of these cases I had no direct data regarding the shoeing, but in later chapters experiments with shoeing will show not only the absolute necessity of the greatest accuracy in shoeing, but also the telling effect of slight changes in hoof and shoe. The necessity of having the distance between the legs that move together the same will perhaps be self-evident. In Fig. 38 we found a difference of 0.173 ft., or 2.07 inches; while in Fig. 56 there is only a difference of 0.06 ft., or nearly ¾ inch. While such a discrepancy may be covered up by speed and a few extra revolutions of the legs, yet there is always this disturbing element in the gait that will tell in the speed for a whole mile. Only when such discrepancy is revealed by an investigation such as this can we proceed toward a remedy.

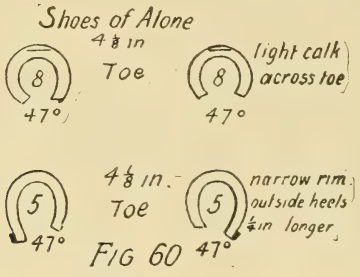


FIG 60

The final requirement for the completion of this analysis of Alone's gait will be, as with Lou Dillon, the actual position of the tracks with reference to lateral or side extension. There is generally much confusion about the lines of motion or the curves described by one foot from one track to its next one. David Roberge has demonstrated, or rather had laid down, the rule of "pointing" as always offering a solution of these directions of feet. He says: *"It may be stated, as an invariable rule, that an animal's right or wrong way of standing is carried out in action, whether it be slow or fast."* (P. 99, The Foot of the Horse.)

Lou Dillon pointed backward a little with fore legs, but her hind legs stood nearly straight; while Alone pointed back a little with fore and forward with hind, or stood slightly under with both extremities. It is interesting to note that Alone, with a longer base (5.03 ft.) between the two pair of legs than Lou Dillon (3.26 ft.), should have the

Fig. 61.

average distance from one pair of legs to the other, or from one side to the other, only 4.82 ft., while Lou Dillon shows 6.36 ft. This may be explained by the difference in elevation and rapidity of action. While the trotting mare has a sweeping and comparatively high action, with special development of hock movement, the pacing mare has a more rapid and lower action. The greater stride of Alone (19.72 ft.) than that of Lou Dillon (19.24 ft.) should really show the greater distance between pairs of legs, if the action were the same. In my opinion the action of the trotting mare is more favorable to a continued effort at high speed than that of the pacing mare.

With Lou Dillon her fore feet were straight in direction while at rest, and her hind toed out slightly. The hind while in motion spread apart somewhat, but the crossing over of fore could not be suspected from their position at rest. She is, however, an exception or a freak in gait. With Alone we come nearer to Roberge's rule. Her hind toed in perceptibly, while of her fore the near was more straight than the off when pointing at rest. In the subsequent table, Fig. 62, we may see this by the results; but it should be remembered that there was a slight swerve to left, and this evidently caused the pointing out of near fore, as well as produced a straight direction or pointing of off fore.

All this pointing may be natural or it may be due to faulty paring of hoof or to careless shoeing. To a certain extent faulty pointing may be corrected by paring and shoeing combined, as we shall see later.

As in Fig. 47, so in the case of this pacing mare, measurements were taken by means of the track gauge with reference to a median line, or a string stretched in the middle between sulky wheel tracks and running parallel to these. This line is staked out carefully by means of surveyor's pins and must follow any little deviation to right or left with the wheel tracks. As a condition for such measurements it is required that the horse be driven as straight as possible, but since an absolutely straight line is seldom obtained, we can depend on fairly accurate results even if there are slight curves to right and left. The curves really compensate each other, and if the trial contains one of each of about the same magnitude one will offset the other in the

measurements. We should, however, avoid one curve to right or to left only, for this will throw the measurements out either to right or left. In Alone's case there was a swerve to left which threw the near hind in and the near fore out. It was all due to her endeavor to go from outside of track to inside, where she was accustomed to speed; but even with that faulty line of direction we are able to see with sufficient clearness the directions of the four feet of a pacer. Even with the conditions of a trial of this sort we must strike a general average, because ideal conditions do not always prevail.

FIG. 62

DISTANCE FROM MEDIAN LINE (TO MIDDLE OF FROG) AND ANGLES WITH SAME (+ AND —)

HIND				FORE			
Near		*Off*		*Near*		*Off*	
D	*Angle*	*D*	*Angle*	*D*	*Angle*	*D*	*Angle*
0	— 3°	+ 2	— 4	+ 2.50	+ 4°	+° 2.50	— 2
— 1.75	— 5	2 75	— 5	.50	— 4	3.50	— 2
— 1.50	— 3	1.	— 4	1.75	4	1 75	2
0*	— 3	0	— 4	3.50	5	— .50	— 3
3.25	— 3	— 3 50	— 6	6.	4	— 3.	5
5 25	— 3	— 3.25	— 4	7 50	6	— 3.50	— 5
3.	— 4	— .50	— 3	5.50	5	0	— 2
.50	— 3	.50	— 5	3.	5	1.50	— 3
.50	— 3	1.	— 5	2.50	6	1.	— 3
— 1.	— 3	1.50	— 4	3.	6	1.50	— 2
+ 12.50	— 33°	+ 8.75	— 44°	+ 35.75	+ 45	+ 11.75	+ 7
— 4.25		— 7.25			— 4	— 7.	— 22
+ 8.25	— 33°	+ 1.50	— 44°	+ 35.75	+ 41	+ 4.75	— 15
+ .825	— 3.3°	+ .15	— 4.4°	+ 3 575	+ 4.1°	+ .475	— 1.5°

* Swerved to left slightly.

In Fig. 62 there are recorded, therefore, the measurements of the stretch of ground containing 10 contacts for each of the four feet, that being the best part of that trial for this final test of lateral extension.

In the total of near hind we have again positive and negative measurements; that is to say, we found middle of frog by the gauge to be on left of median line—or where it belongs by nature—with a total of +12.50 inches, and on the right side of median line with a total of —4.25. Adding these figures and dividing by 10, the total number of contacts, we obtain the average of these deviations from median

line. Again remembering the simple definition or corollary of algebra, viz: "The sum of two quantities, the one positive and the other negative, is the *numerical difference* with the sign of the greater prefixed;" we have +8.25 inches for the total and +0.825 inches for the average lateral extension to the left on the part of near hind. In the same manner, as given in Fig. 62, we obtain off hind as being +0.15 inches on its natural side, or to right side of median line. The near fore

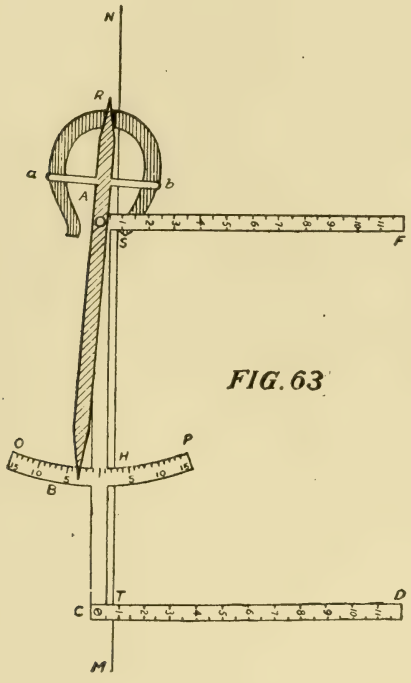


FIG. 63

being altogether on left, or its positive side of median line, we get the average of 3.57 inches on near side; and for the off fore we again have a total on its right or positive side of 11.75 inches and a total on its left or negative side of —7 inches, which added as above gives us +4.75 inches for total result, or +0.475 inches for the average lateral extension to its right or positive side.

With the totals of the angles of pointing in or out, the same calculations can be made, and we have the *toeing in* of both hind abso-

lutely without deviation and to the *toeing out* of near fore to the extent of an average of 4.1°, as well as the *slight toeing in* of off fore to the extent of an average of —1.5°.

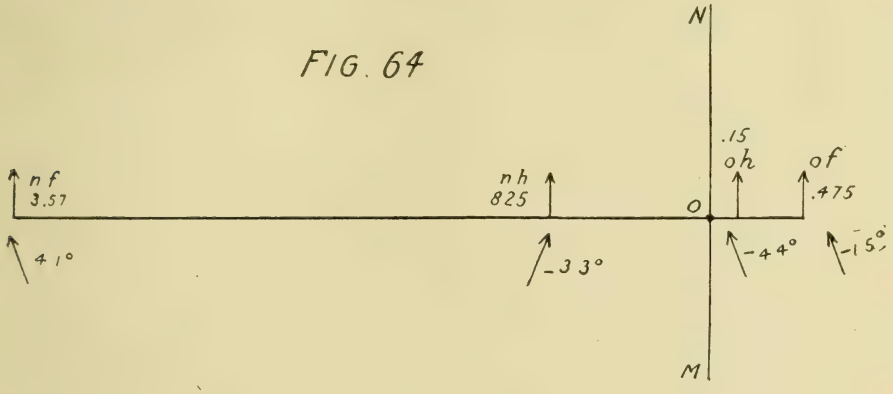
Perhaps it is well to bring before the reader again the application of the track gauge, and Fig. 63 presents the average measurement of near hind. We have here placed the gauge with its sharp point at A in middle between heels and set the distance found from A to S (0.825 inches, approximately ¾ inch) at C to T. Then swinging BR till R passes through point of toe, with little cross piece a b dividing quarters into equal parts so as to locate point of toe more readily, we read off the indicator at B on arc O P as giving 3.3°. Since foot is pointing in or toward median line, its direction or angularity is negative and thus indicated by —3.3°. Of course, this track may be one of a foot on off side, in which case the distance becomes negative, or —0.825 inches, because it is on opposite side of median line; and its angularity would become positive or +3.3°, because the pointing of off foot is in this case an outward one, or to the right, its more natural direction.

Taking the average results as found in Fig. 62 and laying them out on a line at right angles with the median line, as in Fig. 64, we obtain an idea of the average lines of direction and of the angularity of each foot. This represents the actual positions and distances according to averages found.

In Fig. 65 are found the actual condition of the position of feet, as given in Fig. 64, and also a probable condition if swerve to left in trial had not taken place. The two pairs of feet are placed alongside of each other to facilitate comparisons.

Right here I may draw attention to a marked difference between the positions of hind feet in relation to fore feet. In pacers there is a tendency to travel closer behind than in front, while in the trotter there is an inclination of traveling wider behind than in front. While Lou Dillon's gait can not represent a standard gait, all other investigations with trotters and pacers have revealed this peculiarity. In fact, Lou Dillon's gait is the extreme of such an inclination when one considers that the crossing over of fore really means an extreme, or becomes a negative, approach of fore.

Alone wore practically no boots. She had only a heel boot in front and an ankle boot behind. Lou Dillon likewise needed little or no protection, a heel or a bell boot in front and a shin boot behind. While the trotting mare exhibited a marvelous but not excessive action, the pacing mare showed the action apparently best suited to that gait—



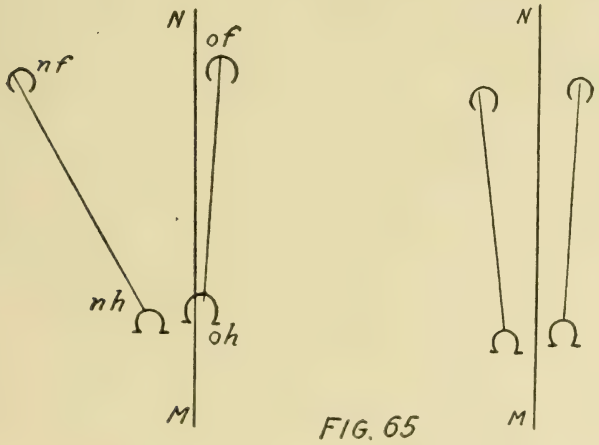


FIG. 65

rapidity and low elevation—and while there was a highly developed hock action in the trotting mare or an approximate equality between fore and hind action, the pacing mare showed the more usual and less elevated action of hock movements.

The trot and the pace are built more or less on similar lines of motion, and their comparison will reveal the fact that there are certain

common principles or laws pertaining to the rapid locomotion of the trotter and the pacer that may be said to give us a certain standard form of locomotion. Taking it all in all, therefore, the average or standard gait of either should result in the greatest symmetry of action, together with the greatest economy of energy and the greatest speed. It is true that there will always be horses that have their own way of going apparently, and this may be due to a peculiar development and conformation. Their defects are often entirely offset by muscular and structural compensations. In all such cases, however, the locomotion must be along lines of directness and symmetry; otherwise there would always be a lack of balance and of speed.

This method of investigating a gait will at all times give us a clearer idea of such modes of motion, and therefore enable us to correct any unevenness of gait all the more readily. In the small manual books, which I intend to offer for that purpose, this method is set forth in a more concise form, and they would materially help the investigator in getting at the truth of an irregular or peculiar gait.

FIG. 66

CHAPTER V.

THE REQUISITES OF PERFECT BALANCE.

I.—The Constant Shape of Hoof.

David Roberge tells us that the foot of the horse "points in the direction of the elevated part of the foot." His remarks deserve to be quoted:

"The foot which enjoys perfect equilibrium to-day will have lost a portion of that equilibrium by to-morrow, and this law goes on increasing every day until the overgrowth of horn has destroyed the horse's due balance so that he can neither stand nor travel at ease; thus showing that this extra growth of horn requires trimming and paring very frequently in order to preserve the balance which results from the maintenance of the proper size and proportions of the hoof."

"Any increase or surplus growth of the hoof, whether at the *toe* or at the *heels* or the *sides* of the foot, will cause the horse to *point with his foot in the direction of the elevated portion of the foot.* Whether it be with the toe of the *hoof* or the toe of the *shoe,* he will *invariably* point in that direction." (P. 14.)

The author says elsewhere: "* * * the normal condition of the foot and leg and the harmony of movement while in motion depend absolutely upon the perfect equilibrium of the foot." (P. 22.)

Roberge called his principles a theory. The term is misleading, inasmuch as it often is used as the opposite of *practice.* His theory has the deeper and more scientific meaning of an exposition of certain principles upon which certain practical results or facts are founded. By seeking for a common cause of the difficulties of balancing and of the facts observed by him, he endeavored to place shoeing upon some scientific basis and thus eliminate from it the mystery of chance. His

theory of pointing is such an explanation of facts. It was the first rational effort to evolve a definite meaning of "balance," and to deprive balancing of the element of luck and—ignorance. His theory of pointing is not sufficiently understood, I believe, and because I was eager to demonstrate what he simply stated from his long experience and convincingly based on principles, I set out on the present investigation of the two gaits.

Too much importance has always been laid on the weight and shape of shoes. It was never sufficiently recognized that balance was not altogether in the shoe. Shoeing is always a necessary evil, and the bare foot is the best shod foot, unless we take careful notice of the hoof and its continual growth. The intelligent shoer of to-day must be able to do as much with the rasp to effect balance as with the making of a shoe. No better authority could be given to him than the reasoning contained in this theory of pointing. It is not impracticable, but is itself a line of principles applicable to *all conditions* and explaining facts previously found.

Before going into demonstrations of the effects of paring and shoeing the hoof, I wish to call attention to the equally sound and scientific theory of paring the sole and rim of that hoof. He says: "At the point of union of the wall with the sole, there is a line of whitish horn which might be called the line of safety. The rule then is that *every horse's foot should be cut down to this line of safety* before having a shoe applied to it."

As to the proper size of hoof a horse should normally have, he is again as positive in language, namely:

"The *white line* that marks the junction of the sole and the wall shows precisely the size each horse's foot ought to be, other things being equal" (p. 56), and "all horn projecting beyond the line of union of sole and wall should be removed." (P. 58.)

This is the fundamental principle of a sound foot, and the keeping of that horny box in a rational shape cannot help being the fundamental principle of balance. It is hard to convince the "long toe man" of the strain of the leverage from heel to toe, and the idea is retained that with each stride the long toe registers half an inch or an inch

gained. This is poor reasoning, for we deal with animal locomotion where energy is the fuel. The greater the leverage at toe the greater the energy expended, and the greater the energy expended the less likely can an increase of speed or of stride be expected. Granted even that a stride is thereby made a half inch longer, it does not follow that with an enforced greater energy the horse will maintain a greater speed for the given distance; nor is it true that such increased leverage at toe will cause greater rapidity of action.

In fact, we know by practice and experience that squared toes increase action and rapidity of motion at the expense of extension, such as is shown by the same foot with a round toe and under the same conditions. There is an exact proportion between speed, length of toe and energy which might well be expressed by saying that the longer the toe the greater the amount of energy necessary to acquire the same speed, and the easier the leverage at the toe the less will be the energy required to maintain that speed. Rapidity of action or motion, it may be argued, requires as much and more of that energy than the long sweeping stride. It is the initial effort, however, which overcomes the resistance of the leverage of toe, or of the length of the lever represented by the ground surface of foot from heel to toe, that constitutes the greatest strain and hence the greatest initial energy. And again, the greatest amount of energy during action is spent in the effort of propulsion, and this effort is entirely placed at the toe of the foot.

Therefore it has always seemed almost criminal to me for any man, be he trainer or owner, to neglect the ever-growing hoof, whether same be on a horse he works or on one he has turned out to pasture. In any well regulated business records are kept of incidents, prices or figures of previous years and of various matters for comparison with similar data of every month as it passes. Why should therefore the business of shoeing, that which preserves balance, be left to an imperfect memory and to guess work?

If the foot has a certain frontal length, say 3 inches, from tip to coronet, and the angle which sole and heels make with this frontal surface at toe is 49° and the *horse is well balanced,* why is this not made part of a record of shoeing besides the weight and shape of shoes?

Why do we hear everything about the ounces the shoes weigh and nothing of the length of toe and angle of foot? Is it not reasonable to suppose that having once established the conditions necessary for a balance, that these same conditions of length of toes and angle of foot would bring about the same balance at the next shoeing? These same conditions prescribing the former length and angle of toe will show definitely how much of the hoof is to be rasped off. There is no error possible where a businesslike record is kept. There is no guess work possible either. Were such a record kept from one shoeing to another of the length of toe, of its angle with heels or sole surface, of the size, weight and shape of shoes and of their application, the horse would have a chance to improve himself instead of being thrown off his gait by an approximate guess and approximate work. Were exact methods employed, the gait would not suffer, but would be more firmly established, or if in spite of this there would appear any irregularity the method of simple measurements as here offered would reveal the fault and indicate the remedy. The prevalent superstition of "leaving well enough alone" and all its attendant mysterious guess work has done the greatest harm to the proper balance of the horse. To the toe of the previous shoeing is added or left some more toe because the *horse was moving well.* Then at a subsequent shoeing some more toe is left, because it seems good to "leave well enough alone." All at once something happens, or speed is lost, and off comes the toe again. In all these operations no heed is given to the angle of the foot. It is lowered indiscriminately as the toe is lengthened and the leverage at toe is greatly increased thereby. The energy of the animal is overtaxed and the ease of motion ceases. Harmony of action is destroyed, and if speed is not diminished, the gait is apt to be of the "get-there-anyhow" style.

There is no doubt that many horses have their own peculiar gait, and we may therefore be obliged to conform our endeavors of improvement to the limitations of that particular gait. But as a rule the kind of trot or pace that is productive of great speed with ease is largely the result of following those principles of motion given in a previous chapter. That means a rational development of an ideal trot or pace.

Such a procedure, however, does not imply that horses are to be shod or balanced according to a preconceived plan to which they are supposed to accommodate themselves. This would be the *method of persistent repetition,* with its inherent make-or-break policy. It is like fitting round pegs into square holes or square pegs into round holes. In no such spirit is it urged here to conform to ideals of motion or gait by any such means.

We may have to force the subject to abandon certain habits if conformation allows, but in order to do so intelligently we must have a definite knowledge of the gait and a definite understanding of the effects of certain changes.

In other words, a study of the compensations in the make-up of a gait would enable us to strike as good an average for the movements and for the speed of the subject as the make-up of the subject would allow. The analysis offered in the previous chapter gives just such a definite knowledge of the matter under investigation. From it can be derived that definite plan by which the gait can be ascertained at all times and from which such improvements could be followed as would tend to perfect that gait. Or again, if under such an exact method no definite improvement in gait and speed could be attained with all the skill of American shoeing at command, then it could still remain a quick and economical method to determine the subject's inability to trot or pace fast.

In Fig. 67 is given a scheme to make a record of the make-up and individuality of the animal. It embraces the main points involved in conformation and gait for speed or the lack of it. The attitude from the side (profile) and that from in front (en face) are most important features of such a preliminary examination. Under "articulation" is meant the way the legs and feet are united at their joints, or how the extremities are hung and how they are inclined to move thereby, with special reference to the flatness of knee and ankle and to the free position of elbow and stifle joints. Under "gait and action" the direction and elevation of leg movements are meant; and it is important to designate the difference between the fore and the hind legs, which is so necessary in determining the harmony of motion.

In Fig. 68 I desire to present a chart for a record of shoeings as they occur in the effort to improve the gait or rather to effect a proper balance of action. The forms of shoes are given only in outline, and they are left open at heels to facilitate additions in the shape of heels when so wanted. Calks on the web itself, in any manner desired, or bars at heel or toe, can be easily filled in with pencil or pen. The lines for the lengthwise sections of shoes can also be readily marked down

FIG. 67.

INVESTIGATION OF GAIT.

Subject :
Sire : Dam :
Sex : Age : Color :
Marks :
Height : Weight :
Length :

ATTITUDE (Profile)

Front : Behind :

ATTITUDE (En Face)

Front . Behind :

MOTION (in or out)

Front : Behind :

ACTION

Front : Behind :

OTHER POINTS

Shoulder : Neck : Head :
Stifle : Elbow : Hip :
Back : Loin :
Withers :

FEET

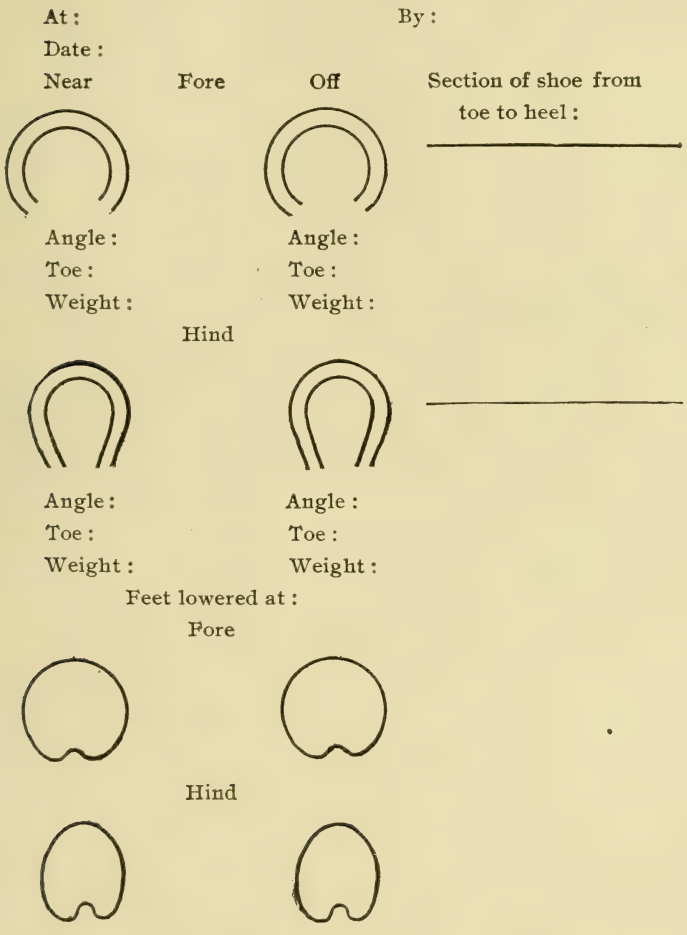
Size : Shape :
Front : Front :
Hind : Hind :

for a record. Finally, the cross section of hoofs are given to show abnormal development, if any, and to designate by pencil the part of the hoof that has been intentionally lowered, giving reason therefor.

This, in brief, should be the record upon which should be based all systematic effort to effect balance. Without such a system we are apt to grope in the dark. Memory, be it ever so good, cannot be entirely relied on, and the necessary details upon whose exact execution depends the result escape our attention. For years I have worked out

cases by books specially designed by me in just such exact a manner, and find it very easy to get an inside view of the locomotion of a particular case. From many cases so investigated I shall present certain deduc-

FIG. 68.
SHOEING.



tions which, based on actual experiments as they are, will very likely be of some assistance to those interested in our American trotters and pacers.

II.—Paring the Hoof to Counteract Its Growth and Faulty Directions.

In a previous chapter I have endeavored to prove that the stride of all four legs must average up the same if the horse continues to trot or pace. The slight increase or decrease that is now and then found between fore and hind legs is merely due to a temporary increase or decrease in speed. But to speak of one leg having a "shorter stride" is not only misleading, but erroneous. What is meant is that such a leg lacks equal forward extension. It would therefore be more cor-

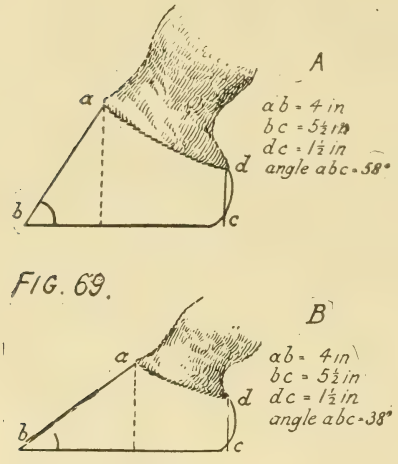


FIG. 69.

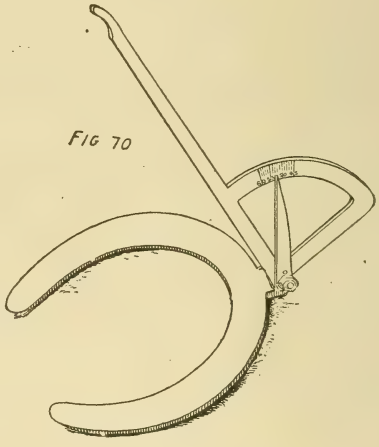


FIG 70

rect to say that such a leg had a "short extension." So likewise there is a confusion of terms when the "long" and the "high" toe are spoken of. The toe can absolutely have *only one dimension* and that is length from the coronet to its tip on its frontal surface. We can not speak of its being "high" because even in its relation to heel it rests with latter on a plane considered practically level. No point in a plane can be higher than any other. We are now considering the unshod hoof whose sole surface constitutes that plane.

In Fig. 69 we have two hoofs whose toes are both 4 inches long and whose lengthwise sole surface is 5¼ inches. In both cases the height of the heel, or the vertical distance of d to c, is supposed to be

1½ inches. For argument's sake the angles are abnormal and impossible, being approximately 58° in one and 38° in the other case. The only variable point in both cases is "a," this being the point at coronet of frontal surface a b of toe. This point *a* varies in height in direct proportion to the size of the angle a b c. It is this point *a* that gives to the untrained eye the impression of elevated or "high" toe, while in reality it is a *"high coronet"* only.

It is at all times possible to measure the length of toe from a to b, and by means of a hoof gauge, such as is seen in Fig. 70, we can readily determine the angle at toe, or that angle which frontal surface line of hoof makes with the plane of sole surface. In considering the heel it may be permissible to speak of a "high" and "low" heel, because of its more vertical and less extended dimension. The heel can be measured, it is true, but not accurately, and it is determined by the angle of the toe. It can be called "high" or "low" on account of its more fixed position and its small variation in dimension, which is practically on a vertical line and hardly exceeds ⅜ inch in total variations.

To illustrate the relation of heel to toe, let us look at Fig. 71. Here is a hoof whose continual growth is indicated in C by surface between f e and b c. In its untouched form it appears at A. There are three ways of reducing the horn of the hoof, viz:

(1) By leaving the toe and *lowering* the heels, as at B.

(2) By *shortening* the toe and leaving the heels, as at D.

(3) By both shortening the toe and lowering the heels, as at C.

In the first case (B) we reduce the angle from 54° to 48°; in the second instance (D), we increase the angle from 54° to 58°, and in the last condition (C), we have the same angle of 54°, as in A. Therefore, we see that the relative length of toe and height of heels determine the angle at toe.

The length of the foot is most rationally and readily determined by the "white line," or that mark of Nature left at the junction of wall and sole of foot, and from these approximate dimensions the variations of heel or of toe will either open or close the angle at toe. If it is not safe to rasp heel down any more, we can close or decrease angle by leaving toe a little longer; and if toe cannot be shortened any

more, we can close or decrease angle by lowering the heels. And, again, if we leave heels untouched and shorten toe, we open or increase angle

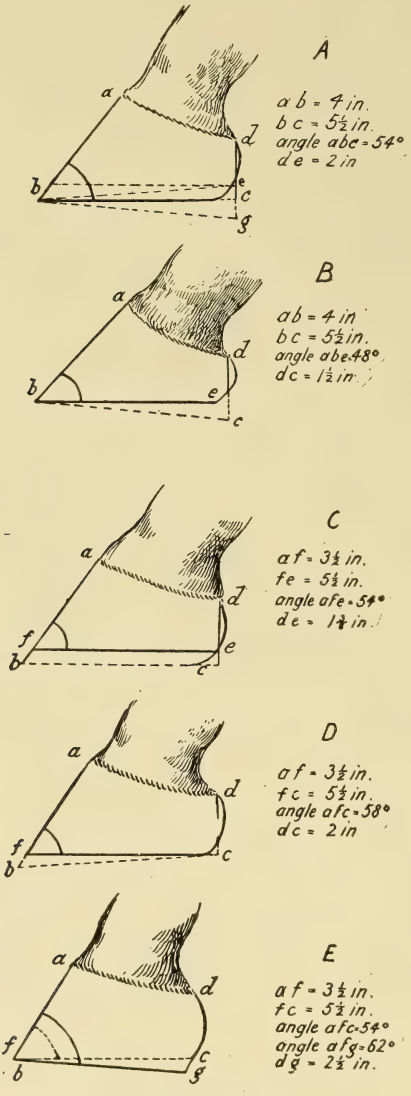


FIG. 71

at toe; or if, after shortening toe, as in E, we raise heels by mechanical means, such as thicker heels of shoes, we open the angle with double effect, as will be seen in E quite plainly.

In all my experiments the rule of pointing, set forth by David Roberge, as regards backward and forward extension, was nearly always verified. A smaller angle meant forward extension and a larger angle brought about a backward extension. I am now speaking of the angle of the foot with the shoe on, inclusive of all the devices of intelligent shoeing that tend to forward or backward extension.

A much more difficult matter is the lateral adjustment or balance of foot. Again, we are forced to put before our mental view an ideal attitude, or a perfect position of the legs as viewed from the front and from the rear. In Fig. 67 the table there given for noting on the subject's points, indicates this particular deviation from the perfect by "Attitude (en face)."

It is generally accepted that, from both the standpoint of beauty and of utility, a line dividing the hoof, ankle and knee into equal halves, should pass through or near the point of shoulder. This line can be called the axis of lateral balance for the fore leg. This line would also be the axis of the so-called "line trot," or rather, it indicates and stands for a plane parallel to the direction of motion of the horse in which the fore leg moves without any swinging to inside or outside. In other words, if the horse moves directly towards the observer, the movements of the fore legs should be confined to these vertical planes.

The same is true of the hind leg as viewed from the rear. Here the axis of motion should again divide the hoof, ankle and hock into two equal halves and pass through or near the buttock joint. This, again, may be called the axis of lateral balance for the hind leg. This line would also be the axis of the plane for the so-called "'line trot" of the hind leg. When, therefore, the horse moves away from the observer, this axis should indicate the perfect line of motion as regards lateral extension or its faults of swinging in or out. Both these ideal conditions for the fore and hind legs are illustrated in Fig. 72. This is, in fact, the attitude that should prevail with the best and the fastest, as well as the strongest and soundest trotters and pacers, if compensations for other faults do not mar the firmness and stability of the position. An illustration of such apparent equilibrium and firmness of

the four legs is seen in the expression of the attitude of Sweet Marie 2:02 (Fig. 66), and of Sonoma Girl 2:05¼ (Fig. 78).

Variations from such a perfect attitude are always in order, though they really strike the eye as being somewhat out of order. Take, for

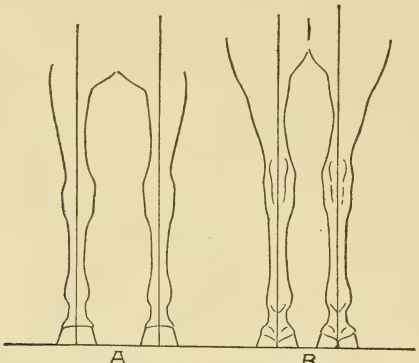
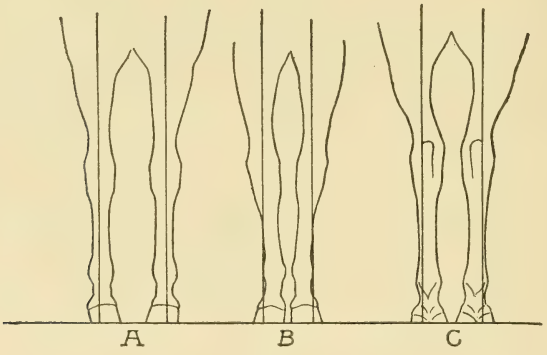


FIG. 72

instance, the attitudes illustrated in Fig. 73. Here we have the fore legs closer together, with toes inwardly set as in A and outwardly set or possibly straight ahead as in B. And with hind feet in the same illustration approaching each other we may have either a straight direction

FIG. 73

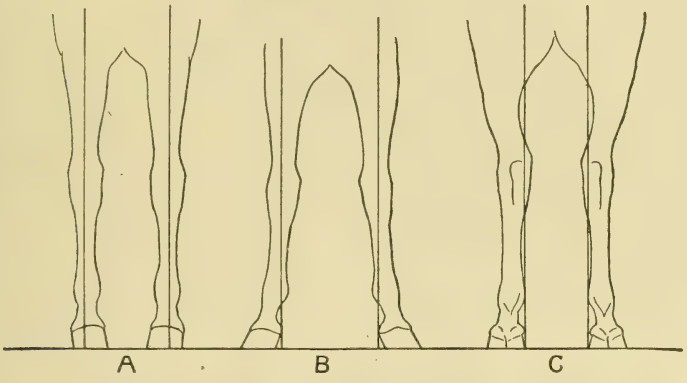


of hoof or one of toeing in. In case the hind toe out excessively, we would be likely to have an attitude more as given in Fig. 75; that is, a tendency to the cow-hock position of hind legs. Again, in A of Fig. 73, we have the position of too free an elbow and a tendency to stumble

with possible paddling of fore. In B of Fig. 73, we have an elbow close to body and may have interference at knee when at speed. In A of Fig. 73, we may also have a possible crossing over of fore legs, although this is more likely to occur with B when direction or pointing of hoof, however, is straight ahead.

In Fig. 74, the legs spread and the lateral extension is excessive. This is due to a wide breast, as in A, with a tendency to toe in, or to a bad direction of leg from knee down, the articulation of both knee and ankle joint being outward, as in B. Again, the feet in A are likely to paddle, and, in B, we have a tendency to interference if separation does not make knee hitting impossible.

Fig. 74



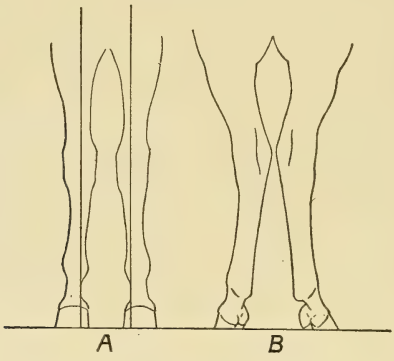
In Fig. 75, the fore legs have a common position; namely, that of the regular knee hitter, the articulation of knee joint being outward with arm above and leg below straight in themselves. The hind legs, with the same tendency, are those of the cow-hocked horse, suggesting excessively free stifle joints and spreading as well as outward swinging of legs. It is *entirely faulty,* both for speed or ordinary work, just as the position in B of Fig. 74 is *entirely faulty* for the fore legs.

We can readily see that even here compensations may figure strongly in the making of speed, or in the absence of interference. Without enumerating all the possible combinations of fore with hind, it may be left to the reader what attitude at one end, even though faulty according to standard in Fig. 72, may be compensated by an opposite

one at the other end, so as to avoid interference and hence produce a good clean gait. As to the hind attitudes, it may be worth while to note that in trotters the tendency is from Fig. 72-B to Fig. 74-C, and with pacers the tendency is from the attitude in Fig. 72-B to that of Fig. 73-C; that is to say, trotters are apt to spread behind, while pacers move hind legs closer together, and vice versa, the fore of the trotter are likely to approach each other, while those of the pacer are apt to separate more.

The fore in A and B of Fig. 73 represent those of the trotter (as a rule), while the fore in Fig. 74 at A and in Fig. 75 show the tendency of a pacer. The latter, however (Fig. 75), is often also the attitude of

FIG. 75



many fore legs of trotters. There are many exceptions, and what is here stated is but the result of the various experiments, from which generalizations have been made.

There are also many combinations of attitudes that must be left to the judgment of the trainer for correction, if such be possible. What the lateral extension of all these attitudes is, can only be found by the measurements with reference to the median line, as given in the previous chapter. Or, if this method does not appeal to some, at least the direction or line of motion can be ascertained by the position and outward or inward pointing of the tracks on ground. There is perhaps more lost motion, lost time and lost energy in unnecessary lateral extension than in the action of legs as viewed in profile or from the side; and, therefore, it is quite as important to accomplish good lateral

balance as it is to regulate the direct extension forward and backward. The proper balance of foot and shoe from side to side or quarter to quarter is, therefore, a matter that requires great skill and knowledge on the part of the shoer.

It is much easier to have ground surface and angle of foot in correct relation. Heel and toe are readily responsive to treatment, but in its lateral construction the foot is often very defective. The fore are not evenly rounded nor are the hind of an evenly oblong shape; and yet the theory of pointing is verified by the motion of misshapen feet.

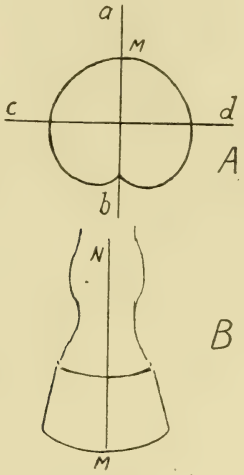


FIG. 76.

The foot, divided by two axes at right angles to each other, as given in A of Fig. 76, should, in ideal lateral balance, show equal or symmetrical surfaces outlined by the rim of the foot; and the axis of leg, as in B, should meet rim of foot exactly at M, the apex of that rim or the point of the toe. Such perfect conditions do not always prevail, but the remedy for such desirable symmetry lies in the application of the theory of pointing, and in following the rule of compensation.

By the rule of compensation is meant the general offset of one defect by an increase of development in its opposite and symmetrical direction. In the conformation of a horse, Nature tries to offset or

equalize faults by strength elsewhere in support of that fault. Nothing in the anatomy or the locomotion of the horse is really and absolutely perfect, and what parts of it impress us as being beautiful in outline or remarkable in expression, are such simply because they are placed in symmetrical equilibrium. We are looking at certain points around which are built the frame and the mass of the horse, and these points are but the centers of symmetry, or the centers of reference, around which rest or move in symmetrical proportion or symmetrical motion, the various parts of the animal.

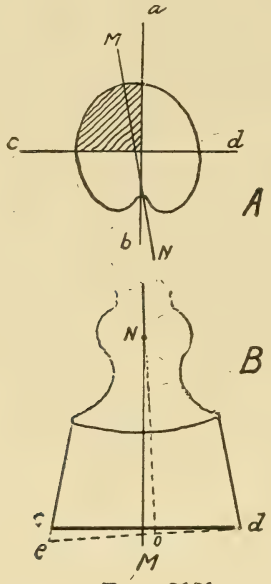


FIG. 77.

This is likewise true of the hoof, and wherever an improvement for a better adjustment is possible, it must be accomplished by the simple principles of symmetry.

If, for instance, the surface in the quarter section from a to c (Fig. 77-A), shows a so-called "wing" or outward curve, the axis of direction for that foot is more likely to be M N, or to one side of axis of leg. The offset or compensation for such a fulness of hoof is an extra height in its symmetrical opposite or of the quarter section a d in Fig. 77 (A). Reducing this full surface in height, as at e to c in

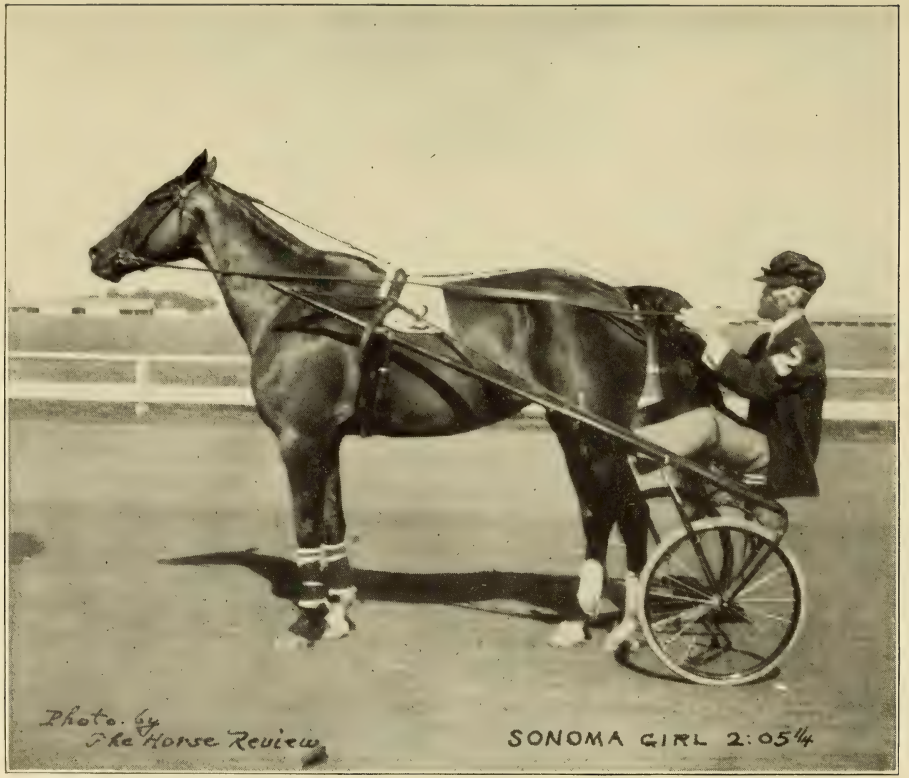


FIG. 78.

B, we readjust the axis M N so that the equilibrium between the two halves of the foot is again established. All this is but a repetition of the simple yet highly ingenious theory of pointing of David Roberge. Again, I must tell the reader that it is not a "theory" as opposed to practice, but an exposition of facts found by actual experience and an interpretation of the principles of equine locomotion. The various parts of the animal mechanism engaged in this locomotion must be in equilibrium to bring about a proper balance. Defects must be offset in some manner, where possible, to cause that equilibrium.

Perfect balance is, therefore, perfect symmetry, or it is the perfect equilibrium around those points of reference in the horse, whether at rest or in motion, by which we unconsciously judge his conformation and locomotion.

"A perfect balance is perfect repose at rest," says Roberge, and to emphasize this dictum the picture of our California phenomenon, Sweet Marie 2:02, adorns the first page of this chapter.

I now present another marvel from my State, Sonoma Girl 2:05¼. Like the other mare she is at "attention." In both there is "perfect repose"—perfect balance.

It seems natural for these two mares to stand squarely on their feet. Here is an attitude worthy of study and one that should be proclaimed as standard. To the lover of the horse, as well as to the connoisseur, this "perfect repose" seems to guarantee harmony of motion and symmetry of action; it carries within itself great possibilities of endurance and of speed. Though I have had no opportunity to see either of these mares trot or to observe how they are shod, I know from experience that in spite of all their perfect balance there must have been expended on their development infinite care, patience and thought. Though Nature may have provided an almost perfect piece of animal mechanism, there is as much credit due to the men behind these mares as to the men behind the forge, because, during the development of such an animal in strength and capacity and speed, continual and intelligent attention must be given to a progressive correction or adjustment of balance.

The growing hoof—for it grows continually and sometimes un-

equally—is a growing evil, as Roberge says; and one shoeing does not remedy a previous fault, unless we check that growth or confine it within such definite limits as are required to effect the same or a better balance.

The four sections of the bare foot as given in Fig. 76, indicate the four general directions in which the foot can "break over" or the point at which there is the least resistance because it is the lowest point of sole surface. The leverage of foot by the tendons, as it is rocked over, is at such a point. Trimming the foot to offset this tendency, if necessary and possible, is quite a difficult matter and requires an appreciation and a knowledge of the effects in the gait. Lateral balance is one of the hardest things to determine, in which shoers often fail to use sufficient delicacy of workmanship. A slight rasping at any higher or wider point of hoof, and one that removes no more than 1/16 inch or even less, is often sufficient to direct the foot into a better line of motion. The shoe being a perfect plane—it should be so—must rest evenly all around against the rim of the foot. Therefore any lowering at a certain point will have to be carefully extended and diminished equally on both sides of that point, or else the shoe will not lie evenly against the foot. Here again we have the principles of symmetry, because we endeavor to tip the shoe—or its plane next to rim—toward the point we lower. Merely lowering the hoof at one place of small area does not give that plane the correct and effective incline.

Perhaps it is unnecessary to explain these matters to farriers, and this book is not written entirely for them, but rather for the many men who spend their money and time for the rational development of the trotter and pacer. That is why I insist on recording the peculiarities of either gait for the sake of correcting their faults; and the difficulty of lateral balance, or the direction of foot to either right or left, compelled me to find exact positions of feet and their angles by a median line, or a line of reference midway between sulky wheels, as given in Fig. 62. Although accuracy is required and an instrument (Fig. 44) is necessary, no other or simpler method suggested itself.

Experiments have proved to my mind that the principal work to be done to effect a proper balancing of gait, or of motion and direction

of feet, lies in the shaping or trimming of the hoof itself. I have a profound respect for the men who devise shoes to overcome faults of gait, but in all complicated patterns of shoes so made there is a fundamental idea which can, by simplification of shoe and *proper trimming of foot,* be made just as effective. Great speed, or any reasonable speed, incurs danger of injury to the limbs of the horse, and the simpler the shoes, or the more compact in design, the less danger is there from missteps, interference, shocks and twists.

The final test of all shoeing rests in its serviceableness. Designs that wear off quickly require too frequent a shoeing, which proves injurious to the hoof. Therefore simplicity of design is one of the important requisites of shoeing. Shoeing should be secondary in importance to trimming the hoof according to the rules of pointing. It should supplement the defects of the hoof and induce such changes in gait as tend to restrain or aid extension and action. And again I must remind the reader that the real effect, the actual outcome, of all this combination of trimming the foot and protecting it, called shoeing, can only be accurately obtained by an investigation of which this book treats. Even with such definite knowledge it will be difficult enough to work out this problem of balance, but it seems a far saner way than to mystify ourselves by trusting to luck or haphazard changes, which are bound to land us in a labyrinth of confusion.

The analysis of the gaits is after all no mystery at all and trainers would do well to become familiar with its main features if not with its details. There are always enough highly skilled farriers to do one's bidding just right and they would succeed a little better still in the way of balancing a horse if they had the trainer's definite knowledge of the horse's gait and its deficiencies. Accuracy, scientific accuracy, time, perseverance and thought will accomplish a great deal, and in these there is no mystery, except it be in their happy combination as often seen in the genius of the man behind the horse.

Very much depends on the proper use of the hoof gauge (Fig. 44) to ascertain the angle of toe with the surface or plane of sole. The plane A D B in Fig. 79 represents the surface of sole and the plane L C H is at right angles with it and is supposed to contain the

axis of leg, or the perpendicular line dividing the leg into symmetrical halves. At E we have the point of toe of a foot and the angle of such a point (K E H) if measured by any line, such as E K in this perpendicular plane. The angle sought is therefore contained in two planes

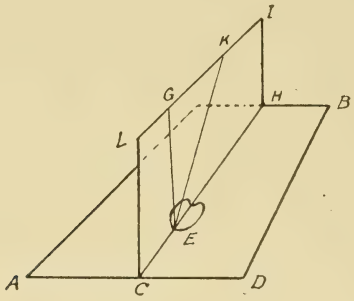


FIG. 79

at right angles with each other, one of them cutting lengthwise into two halves the hoof in question, whose sole surface rests on the other or horizontal plane.

The hoof guage denotes the angle exactly in that manner. In case the frontal surface of hoof is uneven or bulgy, such uneven line could

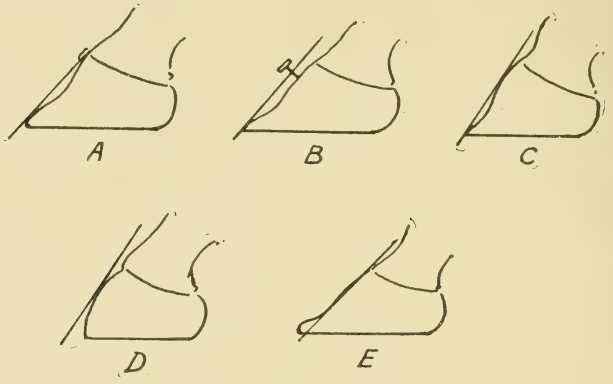


FIG. 80

be averaged by the eye by means of a small thumb-screw in frontal bar of gauge, as given in Fig. 80, where the bar is parallel with the main frontal line of hoof. It is also well to rasp off a little bulge in outline so as to adjust the gauge properly. Ordinarily the difficulty of a nice

adjustment is not so great; but unless the frontal line is well defined and closely follows bar of gauge, there is likely to be a difference between opposite feet, which may account for an irregularity of gait. The bulging coronet, and the dished toe, is the most annoying combination, as at A, which can only be averaged up by front line of gauge.

The range of angles for front feet is from 45° to 52° and for hind feet from 48° to 55°. In the natural state, the hind foot is generally steeper than the fore foot, just as the hind pastern is generally steeper than the fore pastern. The direction of the pastern is recommended as the indication for direction of frontal line of hoof. This direction of pastern continued on hoof to ground seems to present the most natural leverage for leg at toe. As a rule, the fore feet should have same angle with regard to each other, and so, likewise, the hind feet.

Right here a few remarks about "pointing" will illustrate its practical application. If we have the near fore at 49°, and the off fore at

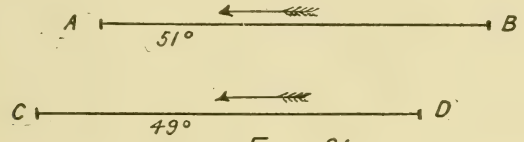


FIG. 81

51°, their relative extensions can be presented, as in Fig. 81, where C D—the near fore—extends farther forward but correspondingly less backward than off fore, A B; both moving in the direction from B to A and from D to C.

Photography has shown—and the tracks on ground testify to the same fact—that the heel of the stiffly extended leg is the first to strike the ground. It, therefore, seems reasonable to suppose that the lower the angle—that is, the lower the heels—the greater the forward extension; and because the heel leaves the ground first, or before the toe, it is evident that the less the angle of the foot, or the lower the heel, the less will be its backward extension. So that with these two feet of different angles, we find a greater pointing forward by C D or near fore, which has the lesser angle. In both these cases it is presumed that length of toe is the same.

I do by no means advocate any indiscriminate or sudden change of angles to effect a change in pointing. Sudden changes are always a menace to soundness and something is likely to snap or break.

It should be remembered that a difference of 1° or 2° makes quite a difference in the height of the heel, even at so small a distance of 4 to 6 inches, which is generally the length of foot. A strict adherence to definite angles cannot be too strongly recommended, provided suitable angles have been found. Proper angles and their repetition at each shoeing insure safety from injury to the tendons. But even with all the care of angles the ground should be consulted and notes should be taken of any concussion of web of shoe. Where persistent striking of ground by parts of the shoe is seen something must be wrong. If it is at heels, they are either too high or too long in foot or shoe. If it is at toe alone there is generally a weakness of extension of foot which is hard to remedy. And again, if these concussions occur in the region of the quarters they point to a wrong direction or axis of leg or foot, or of both. In all such observations we may or we may not effect a cure, but we are at least always aware of the real disturbing causes. We are not groping entirely in the dark as we do when we change shoes only just to try something else and judge the gait entirely from the *seat of the sulky*. Incidentally, I may remark that subsequent trials or experiments will show the advisability of unequal lengths of feet and of unequal angles where deficiencies exist. The greater the speed, however, the smaller the changes necessary.

III.—The Shape of Shoes as a Corrective of Gait.

A few remarks on the shoes to be applied are now in order. Since I do not claim to be a farrier, the question of the kind of shoe to be applied should in fairness be left to the skilful man at the forge. Our country has brought out some great men in that line of work. The development of the standard bred horse has shown that in a remarkable manner. All I want to insist on and emphasize with much ardor is that shoes so made and applied should *always* show the foot to come in contact with ground firmly, distinctly and lightly. There must be

no apparent distress by concussion and no loss of time by the slipping and sliding of any part of the shoe. Only when the contact with the ground by the shoes is firm, distinct and light can the horse be said to move with ease and effect in his endeavor for speed. Any other evidence on the ground may reasonably be taken as showing both defective gait and imperfect shoeing.

The capacity to take infinite pains has been given as the definition of genius. It is this fine spirit that marks the American trainer of trotters and pacers; and the wish to help him in his work is largely responsible for the publication of this book. The trainer, and for that matter the owner, should be able to minutely advise the farrier as to how the horse moves and handles itself. He should know the gait by the record on the ground and should be able to tell what he wants. However much he may hope to accomplish all the work in the sulky, it would at times be a good plan for him to stand off and watch his horse move past him driven by an understudy. This would give him time for observation and possible calculation of ground evidence, all of which is by no means lost time. It does one good to get away from the grind of everyday routine and do a little gazing and figuring. To rest one's hands and think has to my knowledge often been the beginning of better work afterwards.

Aside from the fact that the iron rim called a shoe is a protection for the brittle horn of the foot, there enter into its effect on the gait two distinct qualities, namely, weight and shape. Judging from what one hears generally of shoeing or any particular change in shoes, the most important feature of it seems to be weight. So many ounces in front and so many ounces behind is the whole song of shoeing one hears. Never a word of shape, or toe or heel or angle, but always weight and weight as the paramount issue! In all his discourse on pointing, Roberge hardly ever mentions weight, but he does harp constantly on the *shape* of the *foot* and the *shape* of the *shoe*. Weight has only relative value; that is, when applied in conjunction with certain conditions of angle and toe length. Our ultimate aim in balance should be the principle: *the lighter the shoe the better for the horse*. The effect of weight is not fully understood and the import-

ance of mere weight is largely overestimated. Weight in general increases action. Under certain conditions, it increases extension or reach. With the fore foot it develops the folding of knee and the trajectory or path of toe is more elevated and is likely to be less extended, while with the hind foot it also develops elevation with certain shaped shoes, but as a rule causes more extension or reach of foot. On the whole, weight all round steadies the horse in gait, but at the expense of his energy. Its temporary use is a good educational course; as also are unequal weights on opposite fore or hind feet, which may be required to equalize action and extension. All this I shall endeavor to show in the results of experiments made.

The shape of the shoe is by far the more important part of shoe-

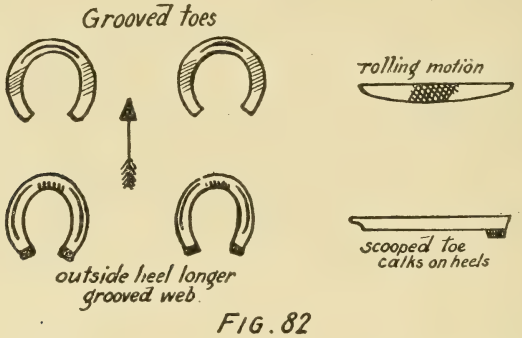


FIG. 82

ing. This has a direct influence on the direction of the leg as well as its motion. Usually shapes so given or illustrated never present the longitudinal section of shoe but only its horizontal section; and the shoe is given with ground surface up or as applied to uplifted foot. A crosscut lengthwise of the entire web of shoe is as essential in understanding its effect as the flat surface drawing. In Fig. 68, which gives a blank record page of proposed shoeing, the shoes are represented as being on a standing horse; and it is presumed that the view of these patterns is from above, with sole surface of shoe on ground and with the direction of motion the same as in riding or driving the animal. In Fig. 82 such a view and direction is represented. Any peculiarity, such as swelled or grooved web, scooped or grooved toe, or calked heel, is given directly as it is on ground surface and as it

would affect the gait of the horse in the direction of the arrow. There is some confusion of ideas of the shape of the shoe by inverting it, because when we look at a shoe of right hind foot, for instance, we generally handle it with ground surface towards us and heels down, so that a longer outside heel would appear to be on the inside, and so forth, something like the image of a subject in a mirror.

If the designation or scheme of Fig. 82 is not agreeable we should logically present the four shoes as in Fig. 83, where they appear as on the uplifted leg, namely, with heels up and toes down. With the understanding that the direction of moving feet is as indicated by arrow, this would in reality be the more desirable and perhaps more logical representation. But I believe that Fig. 82 is more easy of comprehension if we imagine the true character of ground surface indicated

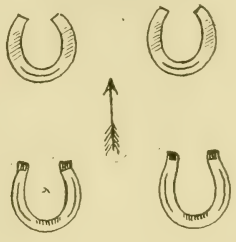


FIG. 83.

as if showing through shoe, as there given. At all events the "pointing" of foot is better understood and corrected, if possible, by viewing them as set on ground and pointing in the direction in which the natural motion of the horse proceeds. Therefore I have adopted it as the most convenient plan for records of past shoeings and of improvements based on the results of my analysis of gait.

The great underlying principle of rocking motion as exemplified in all flesh-footed animals should never be lost sight of in the construction of a shoe designed not only for speed, but also for preserving soundness of leg. I believe that the trotter and pacer have been grossly sinned against in the name of speed by the construction of shoes solely to effect speed, or rather to correct in some forcible way the interference of feet or the action of legs. Weight in front and

calks behind have done no end of harm; but to-day there is evidently a tendency for simplicity in shape and lightness in weight, and this is a move toward a better and less forced gait.

The rolling motion shoe appears to-day, if not in its pure form, at least as the fundamental idea of construction, for we cannot disregard its great advantages when modified so as to prevent slipping or undue high action.

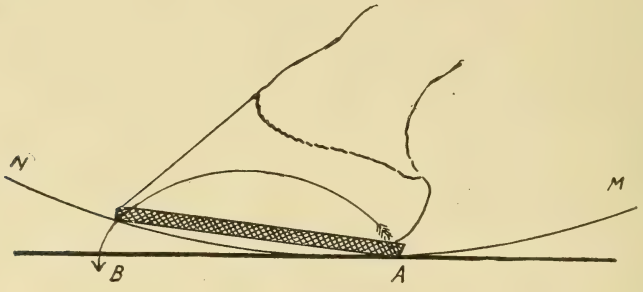


FIG. 84.

In the Figs. 84-87 I have endeavored to show the relative effect of the plain shoe and calked plain shoe, as compared with its corresponding rolling motion form. The curve M N is in each case an arc of a circle and this arc, by its longer or shorter radius, is meant to in-

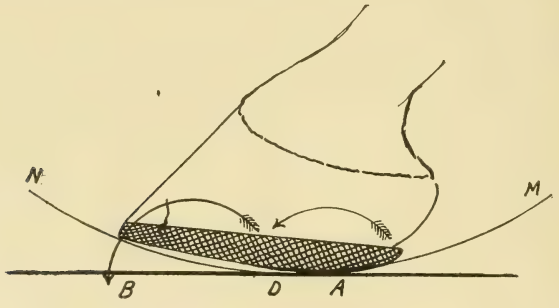


FIG. 85.

dicate the longer or the shorter contact of foot with ground. A B is a lever whose real fulcrum will be at B, when on ground. The ground surface of this lever is straight, and the longer A B the slower will be the motion of the points A and B, and hence the longer the contact

with ground. If, however, this leverage is aided by a number of intermediate points which in succession act as fulcrums with short leverage, the motion of points A and B will be quicker, and hence the shorter will be the contact with ground. That is to say, the arc M N represents in reality the degree of rotation of the foot, and the slower the

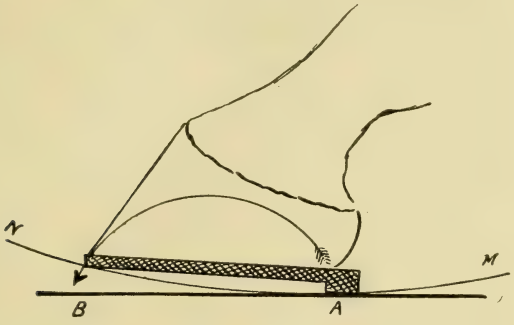


FIG. 86.

leverage from heel to toe the less will be the rotation or elevation of that foot; and the quicker the leverage from heel to toe, the greater will be the rotation or elevation of that foot. This arc M N, or the length of its radius, or the degree of its curves or rotation, depend

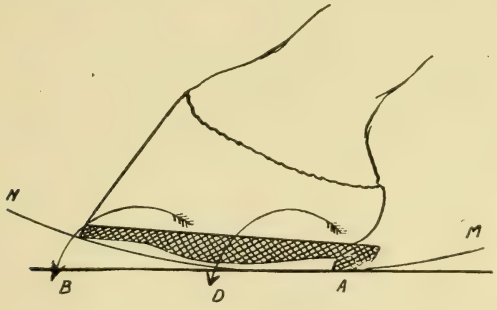


FIG. 87.

therefore directly on the length of A B or rather the distance of A to the nearest point coming in contact with ground after A. Therefore, to quicken and elevate action and particularly to minimize leverage at toe, the rolling motion shoe in its various forms will always remain a sensible type of construction.

The rolling motion shoe has found favor principally as applied to fore feet, but it is as favorable in its effect in the hind action. In Fig. 87 is represented a hind shoe that is safe and well adapted to increase hock action without increasing extension; that is to say, like all the rocker pattern shoes, it shortens the radius of rotation and thereby lifts the foot higher and more quickly.

The general objection to higher action behind is the fear of loss of forward extension; and with this fear is coupled the struggle to get the fore feet out of the way of the hind feet. All of this proves that the action and extension of the hind feet have been much neglected, or but little understood. My experiments will throw some light on this question.

Again, the use of square toes, as may be expected, shortens the extension and quickens the action because of the shorter leverage between heel and toe. Bars across the heels of shoes, besides acting as a protection, have the effect of rolling foot forward by preventing a sinking or anchoring of heels in ground. Likewise the various applications of calks on web of shoe, lengthwise or crosswise, or the full bar across the whole shoe, as in the so-called "Memphis shoe," are nothing but a modification of the rocker pattern with the added improvement of safety from slipping and of effectiveness in taking hold of the ground. The various devices known to all good shoers, such as the creasing of shoe, or bars, or concave or scooped toe, or weighting web, and all the rest, must be left to the emergencies of each case; but I believe that most devices applied are unnecessary tortures added to hard training; and their effect can be produced better by proper training or balancing of hoof itself and in most cases are applied merely because they are *presumed* to improve the gait. No *ground evidence* is sought, and the improvement of the gait remains a matter of chance and of guess-work.

IV.—Simplicity of Rig and the Need of Time.

Let us now consider the various devices of straps and boots and poles and bits and harness and checking the head. As with shoes, so

with the regalia which bedeck the trotter and pacer when he appears on the arena to fight his battle—let it all be simple, sensible and natural. Nothing strangely complicated and suggesting either an abnormal mind or an abnormal animal should be used or seen on the track when the starter lines them up. Nearly all devices are or should be of temporary use only, or for educational purposes only. The horse appearing on the track for a race should be a graduate from his training school and should be free from extraordinary or unsightly paraphernalia of any kind. And, furthermore, should the trotter and pacer appear at ease to please the eye of the spectator. No matter what trainers may say or claim for the defense of high checking, the mere fact that it *looks* cruel besides unnatural should classify it among those remnants of darker days which in the process of evolution refuse to slough off.

Much as I have been a believer in the free head, there is some reason for the humane use of the check line with reference to balance. Any excess, however, in this line of rigging is not only an eyesore, but an act of cruelty. As in other parts of this book I have advocated simplicity as being a part of ideal motion and ideal gait, so here likewise I must insist that the free head should be a part of those ideals. It may be urged that we never have ideal conditions and therefore cannot have ideal motion and ideal gait. But all endeavors for improvement in any line of activity in human life rest on what we conceive to be perfect, regardless of the various compromises that result from such endeavors and fall short of our expectations. All progress practically rests on what idea we carry in our mind of the perfect object. Were it not for such a mental picture, ambition would cease to exist and all growth of knowledge would stop. Therefore ideals are as necessary for the training of our trotters and pacers as they are for any pursuit where development is sought and effected.

The free head generally results from an easy mouth, that ideal quality of a good roadster; and this again depends not only on the good condition of the teeth, which like the feet need continual attention, but also on the hand of the trainer. Too heavy a hold of the lines adds neither to the appearance nor to the utility of the horse.

There is no doubt but what the carriage of head and neck, together with their size and weight, must be considered in the matter of balance. In any correction of gait, however, they are not of primary but rather of secondary importance. First balance must be effected through the foot and the shoe, and with a tolerably or an entirely free head; and then only should recourse be taken to higher checking or to other paraphernalia. The less we hamper the horse by boots and harness or by weights or poles or other devices, the better for his efficiency. If the breeding and development of the standard bred horse is carried on with these principles in mind, or with such ideals of gait and action, his training and preparation will become easier and his appearance more agreeable and natural.

This whole matter of such progressive methods which are likely to bring about simpler conditions can be left safely to the common sense and ingenuity of our American trainers. These will continue to take infinite pains in the development of our unique type of standard bred horses, and to them is due the intelligence, pluck and usefulness of the animal.

The last, and often strangely considered the least, requisite of balance is *time*. We cannot expect an immediate result from any change of adjustment of foot and shoe. The set conditions of a previous shoeing under which the muscles have developed will in a measure interfere with the results of a subsequent shoeing. These hold-over conditions affect also the tendons and ligaments to a degree proportionate to the length of time that those former conditions prevailed. Sudden and complete changes are also fraught with danger. *Only by means of gradual changes and always with a definite object in view, as well as with the records of all changes at hand, can a perfection of gait be logically and safely brought about.* In all experiments or changes it is of paramount importance to *vary one thing at a time*. The demand for a quick correction of gait is too prevalent, and the result is that too many changes at one shoeing confuse the effects of remedies. We deal with an animal mechanism of delicately joined parts, and these parts will not allow a readjustment of its machinery at a moment's notice. Insistence on a marked change, or the total ab-

sence of a definite plan or record of gait, is likely to render those parts liable to a strain and breakdown. It is therefore desirable to allow a large amount of time as a necessary factor in balancing a horse. It has happened that after horses have been turned out or given a rest from continued drilling and wrong balancing, they resume their work with better prospects. That is really because nature had time to re-adjust the animal machinery, and the horse could start under better conditions, or under conditions suited to its capacity. It shows the danger or the folly of *forcing* balance. This "make-or-break" policy is based on impatience and the rush spirit of this country. It has no foundation in common sense or logic or science. By granting time it is not understood that conditions for balancing should be "cut and dried" beforehand and that the process of balancing is to be one of making the horse accommodate itself to these preconceived ideas of balancing. Such an allowance of time is not meant, but rather such time as is required for a careful investigation and understanding of the gait of that particular horse and for the logical correction of that gait by means of the records of the results of each corrective shoeing. What many and careful experiments have taught me and what seem to be the rules applicable to all kinds of horses, I shall endeavor to show in the following chapters.

CHAPTER VI.

EXPERIMENTS AND THEIR VERIFICATION.

I. General Considerations.

The difficulty of experiments of this sort lies in the fact that the locomotion of the horse is a complex affair, and that the conditions and causes from which this locomotion proceeds are very numerous. In presenting the conclusions of such experiments it is hardly necessary or feasible to give the original measurements as was done in a previous chapter. The computations may be relied on as correct. With all the opportunity, accuracy and perseverance at my command, all my experiments were made with a view of drawing from them some general principles applying to all cases. While David Roberge's theory of pointing was used as a basis, there appeared in these experiments certain discrepancies between it and my results, which at times called for an independent line of reasoning. I believe that all observation and deduction in any investigation should be as free as possible from the influence of authority on that subject; for, without the right of independent thought or without a spirit of dissent for the sake of the truth, no progress can well be realized. No authority should be considered as entirely final or unassailable, even though it furnish us with a certain guidance or mental discipline. We can, I believe, be both critical and just at the same time, and this has been my endeavor in dealing with the ingenious principles of Roberge.

Granting, therefore, the assistance derived from the theory of pointing, this investigation was nevertheless carried out to establish facts not contained therein and to prove independently whether at all times and under the same conditions the results would give a general law. All repetitions of like effects from like causes must give such a

general law. It is the rule for all experiments, especially where so many conditions prevail as in balancing equine locomotion, to vary but one thing at a time. When the observer is face to face with a case for which an immediate remedy is asked, he is apt to rush into at once applying various changes. Time, which is so essential a part of balance, is not granted, and impatience demands a quick remedy. A lack of knowledge of the intricate inter-relation of the four moving legs and the indifference to any proof, such as measurements show, will leave the matter of improving the gait to the doubtful process of guessing.

These facts make experimenting extremely difficult, and sometimes unsatisfactory. If, therefore, one change in shoeing does not prove to be beneficial, it should not be conclusive evidence that such a change in itself is harmful. Another change in combination with the first may lead to better results. But without any evidence such as the ground produces, no rational improvement of the various conditions of balance can be effected. What evidence is there? has always been my query previous to planning my present analysis of gait. It was on this account that I was not quite fully convinced of the truth of all of Roberge's assertions, no matter how plausible and conclusive they appeared to be, until repeated experiments proved his theory of pointing to be correct in its main principles and deductions. This method of analyzing the gait revealed certain facts, and the experiments based on them yielded results which seemed to prove the usefulness of such an investigation. The method itself is a logical indicator of correction and may aid the natural ingenuity of the American farrier in the application of the proper shoes. The more I saw that practical and permanent results came from a methodical analysis of a gait, the more it became evident that at all stages of development it was necessary to have an absolute proof not only of the manner of motion, but also of the results of the applied corrections.

It has seemed to me that the presentation of this whole matter of the analysis of the gait is a little premature, inasmuch as it does not give as ample a proof for the pacer as it does for the trotter, and because the corrective shoeing here discussed may not cover every case

in question. But time and opportunity bid me make as good an offering as is possible after much patient inquiry and effort. The experiments worked out on many subjects were sufficiently verified, I think, to warrant certain generalizations. Given, therefore, a certain manner of equine locomotion, the correction of any faults of it may be worked out on such general principles rather than on lines of specific remedies for each individual case. At any rate, my method of analyzing the gait will serve a good purpose even if the applications of remedies differ from those of mine. To my critics I will say that nothing would please me more than if they "go me one better" in the proper correction of a faulty gait by means of my method of analysis or by any other method except guess-work.

These preliminary remarks are intended to impress upon the mind of the reader the importance of correct data on every case under investigation. In balancing the horse in motion one is apt to be guided by the imperfect observations of the eye when such definite data are not obtained.

Shoeing itself is an art, but the correction of faults of gait by means of shoeing and trimming the foot should be worked more on the exact lines of a science. When farriers, therefore, are endeavoring to remove an *actual* rather than a *probable* cause of a faulty gait, they will be able to do work with more satisfaction to themselves.

A remedy in shoeing, such as shape or weight of shoe or length and angle of toe, may not be a permanent one and yet have a good temporary effect. That is to say, we may safely apply a different shoe on one foot for a time only in order to correct the motion of a certain leg, *if we have found such leg deficient in action or extension.* Or, again, we may find, also by this analysis, that there is a structural fault in the leg or the foot which calls for a permanent remedy in the shape or weight of a shoe different from the other three. For instance, one leg may be shorter and we may correct the defect by a permanent lengthening of that leg or shortening of opposite leg. Then there is the "hitch" behind and that peculiar laboring in front, which both cause a rough and unsatisfactory gait. It means but an unequal extension of opposite legs, and no horse can produce a smooth and square

gait with these faults uncorrected. Though the ear may listen and the eye may strain to catch the irregularity, they cannot come up to the evidence on the ground.

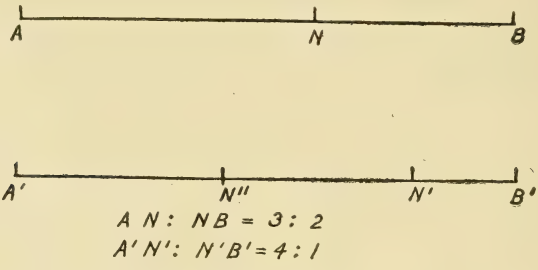
Again, it should be borne in mind that the proper balance of a horse's action, whether it be at slow or fast speed, produces that quality of motion which with the least exertion brings about the most regular and even action.

I have always been of the opinion that the neglect of the hind action is responsible for a good part of the problems of balance. In many horses we cultivate an excessive action in front for the avowed purpose of clearing fore feet from hind feet; and at the same time we do nothing to regulate the hind action. With the hope of bringing about a greater separation between fore and hind feet so as to prevent interference, all efforts seem to be directed toward higher action in front. Somehow it is assumed that such a course will cause the fore to extend forward more and avoid interference thereby, besides increasing speed. My observations lead me to believe that such endeavors are based on a lack of knowledge of the inter-relation of the four legs.

Extremely high action in front must always be considered faulty from the standpoint of utility, as well as from that of beauty. It does not conform to a proper idea or definition of balance. There is also another consideration against it, namely, that of its effect on hind action. Somehow the action behind is hardly ever a subject of correction. It is left severely alone because the prevalent idea about it has been that hind legs should reach as far forward as possible so as to get a good forward hold on ground and effect propulsion. But in all my experience it has always been noticed that the action at both extremities, that is, the sum total of both actions, is nearly a fixed quantity with every horse. It may be slightly increased or diminished as a whole by shoeing and by the consequent development or disuse of certain muscles and tendons; but on the whole the distribution of action between fore and hind could be indicated by the figures 3 and 2, or by saying that three-fifths of the action belongs to the fore and two-fifths to the hind legs. Some may hold it is still more in dispro-

portion and may set the figures at 3 and 1. Whether its total is represented by 5 or by 4, there seems to be a mutual exchange of action between the two extremities. If, for instance, in Fig. 88 we assume A B (5) and A′ B′ (4) to represent the total action of both extremities, then N or N′ will indicate the fixed proportion between the portions of the line it divides as given. While A B is more or less fixed, N is likely to be variable or may be assumed to be so. Whichever way N may move, it establishes the ratio of action by its division of the line A B. If A N represents the front action, then N B, the remainder, will show the hind action. If the front action is increased, as in second diagram, to A′ N′ again, the remainder N′ B′ will indicate the hind action. This is offered only as an illustration of the apparent

FIG. 88



counter effect of one action on the other. If, for instance, hind action is supposed to be increased to B′ N″, the front action will diminish and will be shown as A′ N″. This is not to be taken literally, but only as an indication of the mutual influence of front and hind action.

It illustrates my observations regarding the mutual exchange between fore and hind legs of that nearly fixed total action of both extremities. That is to say, the more action in front the less action behind, and, vice versa, the more action behind the less action in front.

Elsewhere the importance of the services of the trained eye and ear have been emphasized; and in this question of action, which by continual representation fixes itself before the observer, the eye must also be called upon to judge. Again, it is urged that any judgment on the gait should be passed only by some one on the ground while the horse passes by, or, better yet, by some one driving alongside the sub-

ject of observation. The man in the sulky, important as his function is, cannot quite form a correct idea of the action of the horse.

As regards the idea that speed requires extreme forward extension and with it the long toe, toe weights, and what not, it is only necessary to recall the illustrations of a previous chapter concerning the pendulum-like swing of leg as a requisite of perfect balance. Perfect balance will not produce unsoundness such as curbs and swelled tendons, but too great a forward extension is apt to do so. In Fig. 89 are given the points of shoulder (A) and buttock (B) of a moving horse. The pendulum swing of fore and hind leg is indicated by A M, A N, B M′ and B N′, these being at equal distances from the vertical or dotted line. The weight of the horse seems well supported and the parallelogram representing the body and legs of horse moves in

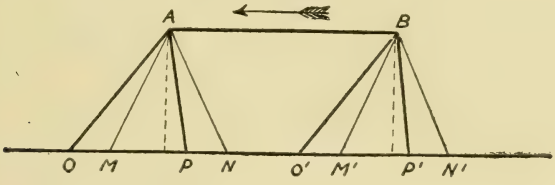


FIG. 89

good symmetry. But let us force the forward extension of legs as indicated by A O and B O′, and we shall have a corresponding lesser extension backward, as in A P and B P′. It is apparent that the support or stability of the parallelogram is weakened every time it is in the position O A B O′, or at extreme extension of A O and B O′. Add to this the fact that the line A B, representing the body of the horse, is, in consequence of such excessive forward extension, lowered more than when such extension is normal, it is plainly seen how unnatural and dangerous such a forced extension may become.

This diagram will illustrate what is erroneously called "lengthening the stride," which in reality means increasing the forward extension. The danger of such a process becomes apparent when both extremities act in the same manner; the belief being held that somehow the hind legs ought to do what the front ones do. While they

ought not do likewise, nothing is done to make hind legs do otherwise, and there lies the trouble.

In a previous chapter I have tried to show the difference between the curves of motion of fore and hind. The fore, by the nature of their flexion, will describe a longer and higher curve, while the hind, incapable of as great a flexion, describe a lower and more direct curve; and it will be noticed in the pictures of the horses in motion that while the hind foot does—and should—strike the ground together with its correlated fore foot, it does leave the ground often a little after the fore; and, again, wherever it does so there is a good backward extension and a good action of the hind legs.

At all times when a horse is going squarely, whether trotting or pacing, and is balanced well, the fall of each pair of feet should take place exactly at the two time-beats. No irregularity about such synchronous contact of the two correlated feet can or should possibly exist when the gait is perfect.

This lingering backward contact of hind would therefore indicate that wherever we induce the legs—especially the hind ones—to extend forward to excess we lose this full effect of propulsion; that is, we lose the necessary backward extension during which propulsion seems to be and is far more effective. Such equalizing of fore and hind action is not an easy matter of a few weeks, but will take months. It should be done during the winter months, when shoeing and gaiting is only too often lost sight of and neglected. It is then just as important as it is shortly before meetings, for *time* is an essential factor in any attempts at balancing. This is the more rational period to produce the greater separation between fore and hind than all subsequent attempts in a hurry can possibly be. On the whole, I think it reasonable not to over-develop the action of fore and to pay more attention to the greater development of hind action. The usual advice given about the interference of hind with fore—and it sounds as wise as it is indefinite—is "to quicken and round up his action in front and shorten his stride behind." Stress should be laid again on the entirely erroneous expression of "shortening the stride." In another place I have taken exception to this idea of "stride," for we cannot shorten the stride of

any one or of any two legs and let the rest of them go along at a longer stride. At that rate the fore would become separated from the hind to such an extent that they would no longer be parts of the same horse. A stride is a step, or a distance from toe to toe or heel to heel of the same leg, as the fashion may be. We can therefore shorten the *four* strides of the *four* legs at the *same time,* but we cannot reduce the stride of one or two of them.

The trouble is that "stride" is erroneously used for "extension" and particularly for forward extension. "Shortening a stride" must therefore be placed in the same pigeonhole as "a cross-firing trotter" or "a scalping pacer," all coming under the heading of "human error." What is really meant is that the forward extension of hind should be checked and a greater backward extension effected. Hence my plea for the power and effect of proper backward extension. This, in fact, is done nowadays to a larger extent by leaving the angle of hind toe greater by 3 to 5 degrees than that of the fore, and by having the toe of the hind shorter by ⅛ to ⅜ of an inch than that of the fore. It is a double application of the theory of pointing, namely, by decreasing the pointing forward with a shorter toe and increasing the pointing backward by a higher heel. There is also, with these remedies, the usual one of more or less lengthened heels of shoe to ease contact and to direct foot. It is at all times more preferable and rational to limit the extent of these long heels of shoe, and the "freak" shoes of former years having these are fortunately a thing of the past.

II.—The Turns of the Track and the General Directions of the Feet.

In dealing with the irregularity of extension, especially in fore legs, mention was made in a previous chapter of the habit horses have of reaching forward with either left or right in preference. In the gaits of the saddle horse this is a well-known feature, but we are not so conscious of such a preference in the trotter and pacer. Investigations, however, have proved that a subject will habitually set one fore foot ahead of the other. It is not a harmful habit, provided the difference of extension does not become excessive.

On the turns of our oval tracks the so-called "left habit" is not a bad acquisition. Ordinarily the horse will lean to the left, thereby shifting its center of gravity to the inside and counteracting the centrifugal force which tends to send the body straight ahead on a tangent to that curve. What is true of the fore legs in this respect is also

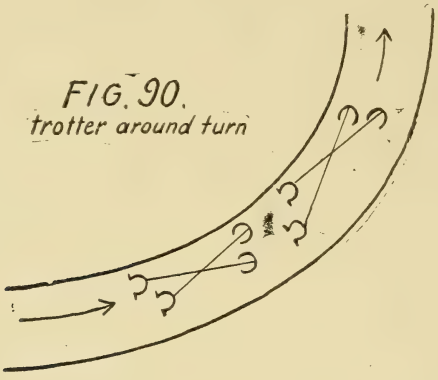


FIG. 90.
trotter around turn

true of the hind legs. The off fore as well as the off hind act as braces against the centrifugal force and their positions on the off side insure a well taken turn. In order to effect a bracing by the off side the off fore is placed slightly behind near fore and the off hind is placed slightly in advance of near hind.

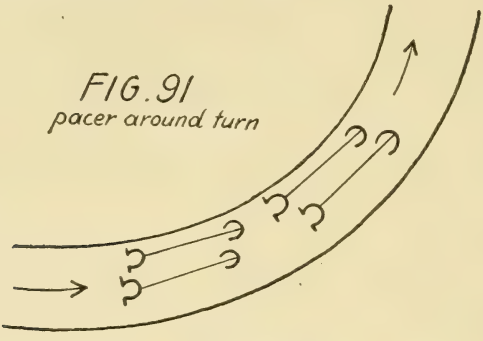
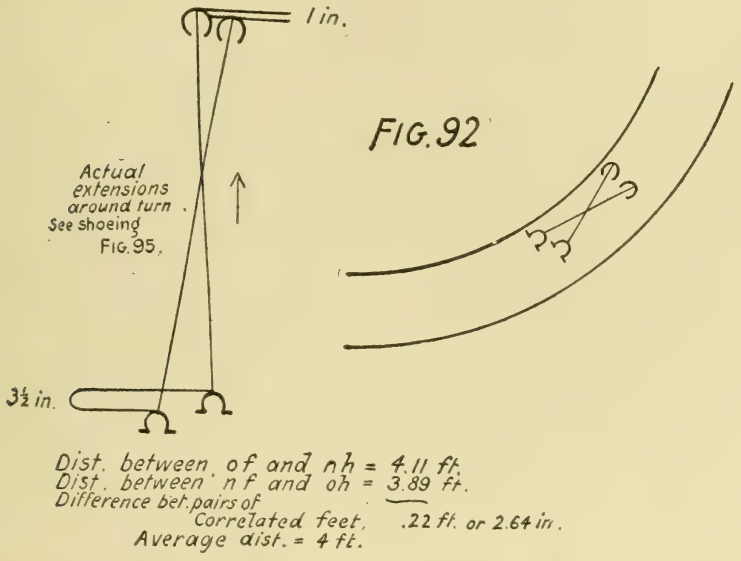


FIG. 91
pacer around turn

Special trials around a curve or turn gave evidence of facts well worth considering. There is always more danger of interference between hind and fore at the turns. The trotter will suffer from such interference on either side and the pacer between opposite sides. It becomes therefore of great importance to ascertain the difference of

extensions on the straight-away course and adapt or modify these according to the requirements necessary for the turn, so that the horse is able, without distress or fear, to propel itself equally well on the straight course as well as on the turns.

Figs. 90 and 91 give each the two possible extensions for the trotter and the pacer, showing the right and the left habit around the turns. In Fig. 92 we have an attitude such as proved to be of great benefit to a trotter that could not take the turns well before such an extension of off hind took effect, as given. It might be well to say


1 in.
Actual extensions around turn. See shoeing Fig. 95.
3½ in.
FIG. 92
Dist. between of and nh = 4.11 ft.
Dist. between nf and oh = 3.89 ft.
Difference bet. pairs of Correlated feet, .22 ft. or 2.64 in.
Average dist. = 4 ft.

that the habit of starting with left or right fore need not necessarily exist, but there may be unequal extensions due to faulty shoeing or adjustment. At any rate, the averages of a straight course will give us the clew to any trouble there may be at the turns. In this particular case, which will serve for all cases, the attitude of the feet, or rather their average tendency of extension, is given to show the requisites for a good position at turns. While it still remains true that the distances of the correlated feet should be equal for both left and right extensions, there must necessarily be a slight variation from that rule at the turns. Here an extra effort is made to counteract direct forward propulsion

and to send the body to the left without loss of speed. We find the near fore averaging 1 inch ahead of off fore and the off hind 3½ inches in advance of near hind.

I regret not having any data of pacers going around the turns, but the reader will readily see why pacers should take the turns more easily than trotters. To begin with, pacers shift their center of gravity more readily from side to side. It is in the nature of their gait. In the diagonal motion of the trotter the center of gravity does not shift so readily to the left at the turns and in the attempt to do so the equality of distance between the correlated feet is apt to be disurbed. With the lateral locomotion not only is the swing from side to side favorable to taking the turns well, but there is always a more natural support with both legs on the outside which are thrust forward at the same time; and there is also a greater possibility to maintain the equality of the distances between the correlated or lateral feet. But for a possible cross-firing there seems to be less chance for a break.

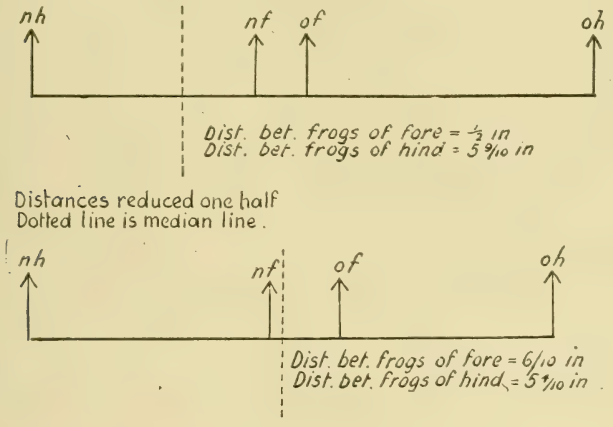
Judging from the mare Alone 2:09-¼, whose gait has been discussed in another chapter, and which took the turns well, it would seem that the pacer as well as the trotter is better able to take a turn by endeavoring to get a good support on the outside. The pacer is better braced against tipping over to outside by having his two feet there always at the same distance from each other, while the trotter has his outside feet move in opposite directions. There is with the trotting action a continual opening and closing of legs on the outside of turn. Therefore, his support is not as steady and may further be weakened by a possible interference, such as scalping or speedy-cutting. While in front his leaning to inside will induce him to carry left fore slightly in advance of right fore, the right hind leg will endeavor, as shown in Fig. 92, to act as a brace and to gain a better foothold and support by preceding the left hind leg. In this effort the right hind leg is carried more to the outside than it would on the straight course, as we shall directly see by comparing the averages of 10 strides taken at curve and at straight course immediately following turn.

In Fig. 93 this comparison brings out the position of these lines of motion with reference to the median line. The median line around

the curve is toward left side, showing the left hind on its proper side, while both fore and the right hind are much farther away from it. It illustrates the force of motion that tends to throw the body toward the outside.

In the straight course (second diagram), the lines of motion are readjusted to the normal and the feet move in their ordinary lines or nearly so. Fig. 94 illustrates again the almost equal extension of straight course (the right fore being now slightly in advance of left fore) and the somewhat lessened extension of right hind over left hind (3 inches). Other experiments have shown that wherever the off hind

FIG. 93



acts in that free forward extension the turns are taken more easily than where it is held back and follows the near hind; but there should be at the same time a slight but not excessive extension of near fore over that of off fore. If such extension of near fore is excessive and the off fore points back too far in consequence, there is again the danger not only of interference with off hind, but also of lack of support by off fore at the turns. The *principal requisites for taking a turn well are, therefore, first, a slight increase in forward extension of near fore over off fore, and secondly, a more marked increase of off hind extension to effect the swinging of the body to the left and to prevent a loss of equilibrium.*

In the straight course, after taking the turn, the trotter in question showed an increase in the difference between the two pair of moving legs. That is, the distance between off fore and its mate, the near hind, was 3.36 inches greater than the distance between the near fore and its mate, the off hind. In other words, while the first pair separated in extension the latter approached. Comparing Figs. 92 and 94, where such tendencies are shown, this will become more evident.

Such are the conditions which favor taking a turn with greater ease, but in this case the difference of extensions was rather too marked to call the gait quite satisfactory. There should be a closer approach

FIG. 94

Dist between of and nh = 4.21 ft.
Dist between nf and oh = 3.93 ft.
Difference bet. pairs of correlated feet .28 ft = 3.36 in.
Average dist. = 4.07 ft.

to equality in the distances of the correlated feet. If the subject has this favorable extension at the turns only, there is not much danger of a disordered gait, for the difference will, of course, be less on the stretch.

While Lou Dillon's gait was exceedingly interesting to observe on account of her marvelous speed and remarkable action, it can not quite serve as a standard for the large majority of slower trotters.

The principal deviation of her gait from the general standard is the crossing over of her front legs. It was an ingenious device to avoid interference, but it is hard to tell whether this was due to her intuition or to a fortunate structural adjustment in her speed mechanism. We may, now and then, find such a mode of locomotion with other trotters, but are more likely to observe that the hind feet follow the fore feet, or nearly so. The trotting or pacing motions usually proceed on straight lines, and in subsequent trials, here shown or alluded to, the line trot and its approximation should always be considered as the usual locomotion of the trotter.

FIG. 95

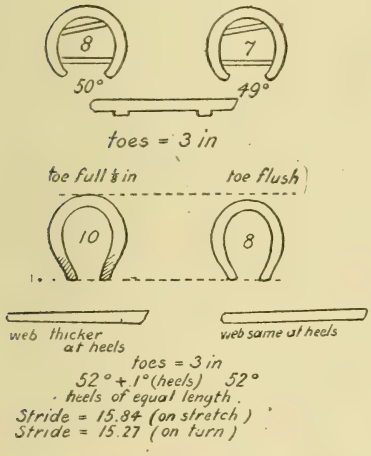
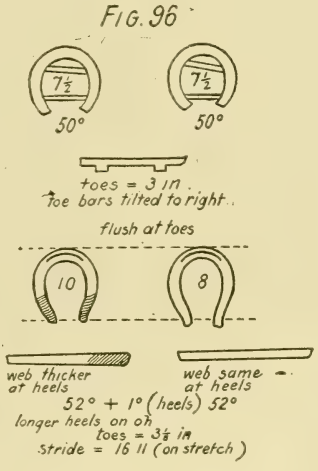


FIG. 96



The subject to be discussed in this matter of taking the turns of the track was a standard bred mare by McKinney with good trotting action and fair speed. Being owned by me she was in my complete control, and I was, therefore, not subjected to another man's limit of time or of patience. This mare, like many other good trotters, responded well to all changes of adjustments, and it was always more of a pleasure than a task to work out the results of her trials.

Shod, as given in Fig. 95, this mare was able to take the turns much better than before. This shoeing was one in a series where slight changes were made in order to ascertain the results of these changes. To understand the effect of the change indicating an improvement in

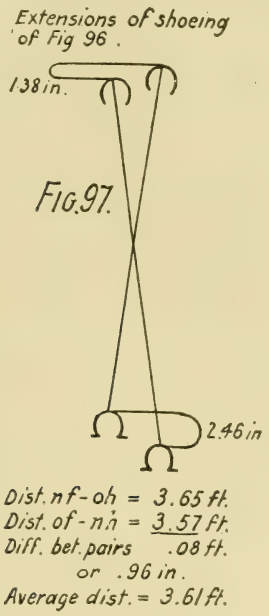
the right direction—even though this does not mean a proper remedy—I give Fig. 96 as illustrating the shoeing three weeks before. There the stride was 16.11 feet, while for the trial, three weeks later, it was 15.84 feet (Fig. 95), a difference of 0.27 feet, or 3¼ inches.

Before we jump at any conclusions why she took the turns better when shod as in Fig. 95 than as in Fig. 96, the latter shoeing should be looked into. With the greater stride (16.11 feet) at the previous shoeing than at that of Fig. 95 (15.84), by a difference of 3¼ inches, there is in the latter trial, on the straight course after the turn, a greater separation between fore and hind feet, and a consequent smaller overstep of hind over fore. According to observations made, we would naturally expect in the slower gait a smaller likelihood of interference between hind and fore, because the extension of both fore and hind is not as great; but here the difference between the strides is only 3¼ inches and yet the average overstep in the previous trial with the 16.11 feet stride is greater by 0.6 feet or 7.2 inches than the overstep of the second trial with the 15.84 feet stride. That is, the overstep of the trial with the 16.11 feet average stride is 4.45 feet and that of the 15.84 feet average stride is 3.85 feet. These differences occur on the same straightaway course after the turn, which later will be considered separately. In proportion the average distance between hind and fore is 3.61 feet in the previous trial and 4.07 feet in the subsequent trial, a difference of 0.46 feet, or 5.52 inches. This separation indicates clearly that such differences do not depend upon the *mere increase of stride* of 3¼ inches.

It will be noticed that the hind toes, or the hind feet, are ⅛ inch longer than the fore feet, the latter being 3 inches and the former 3⅛ inches; and this is an important feature in the separation of the extremities. It indicates that hind had greater extension because of such greater length, as subsequent experiments have proved time and again. Hence, their greater approach towards the fore.

Take the shoeing of Fig. 96 and we have the extension of right fore 0.115 feet or 1.38 inches greater than that of left fore. That is, the right fore travels ahead of the left fore by that much. Behind it was found that the left hind traveled ahead of the right hind by 0.205

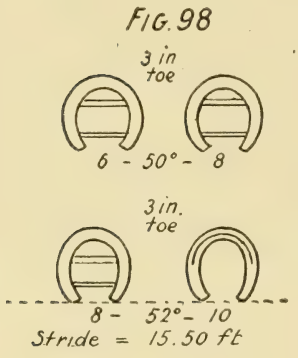
feet, or 2.46 inches, as given in Fig. 97. There is, therefore, a closer approach between right fore and left hind by nearly 1 inch (2.46—1.38) than there is between the other two moving legs. Both front feet are shod exactly alike; hence the difference must arise from the uneven extension of hind feet. In this case the leg that lagged before was the left hind and the foot was given the heavier shoe and the shorter and higher heels. The result is what was expected; but such greater activity of the left hind is transmitted in some degree to its mate, the


Extensions of shoeing of Fig 96.
1.38 in.
Fig. 97.
2.46 in
Dist. nf - oh = 3.65 ft.
Dist. of - nh = 3.57 ft.
Diff. bet. pairs .08 ft.
or .96 in.
Average dist. = 3.61 ft.

off fore, and hence this leg has the greater extension over its opposite mate, the near fore. In many other cases such influence of one foot upon its moving mate has caused annoying results.

As has been before indicated we can balance the feet with reference to front or hind extension, but we must also take into account the interrelation of the fore and hind as they move in closely related or correlated pairs. Hence a change in one hind foot will call for a change in the correlated fore foot, always with a view to having the distances between the fore and hind, that move together, as nearly the same as possible.

Attention should be called to the longer, even if flatter, heels of the right hind, which were supposed to check the forward extension. This shoeing compared with previous ones resulted in reversing the extension behind from the greater right to the greater left extension. Weight of shoes and the length and height of heels are the main responsible features. Weight behind by itself increases extension behind and length of heels by itself is apt to do the same. Briefly stated we have here in Figs. 96-97, an increased extension of near hind—which lagged before—due both to a heavier shoe and to a higher heel facilitating break-over at toe. The longer heels on off hind against such an adjustment favor this extension of near hind. Under the other con-



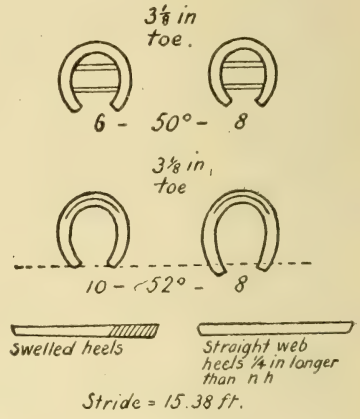
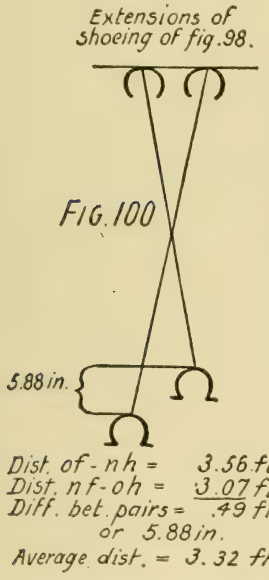
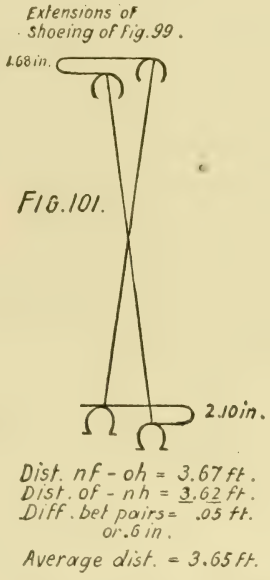


FIG. 99.

ditions of Figs. 95-94, the shorter heels and setting of shoe at toe again brought out the previous excessive extension of off hind, but modified it by the adjustment on the near hind. Incidentally it may be said that shape of shoe is an essential feature in regulating action. For instance, Fig. 98 gives an experimental shoeing to study the effect of action on extension behind. Here we have the Memphis shoe on the left foot and a plain shoe on right foot. The left shoe is 2 oz. lighter than the right shoe. Conditions of toe length and angle are alike. The result was that right hind preceded left hind by ½ foot in extension. The 2 oz. extra weight on the right fore did not seem to effect a greater extension, but in the variation of the strides from the average stride of

15.50 feet, it is evident that the right hind has the greater activity. In fact, the record shows that left hind sank into ground and the toe-mark indicated the disadvantage of such impression as against that of the right hind, which was set down squarely and showed no effort at toe. The 2 oz. extra weight may cause—as it generally does—that activity, but the retarding effect of left hind checks the right fore and as a result we have the average extension for 20 strides equally divided in front, or for each foré 7.75 feet, as given in Fig. 100. And so the increase of elevation of left hind by means of this Memphis shoe has


Extensions of
Shoeing of fig. 98.
FIG. 100
5.88 in.
Dist. of - nh = 3.56 ft.
Dist. nf - oh = 3.07 ft.
Diff. bet. pairs = .49 ft.
or 5.88 in.
Average dist. = 3.32 ft.


Extensions of
Shoeing of Fig. 99.
1.68 in.
FIG. 101.
2.10 in.
Dist. nf - oh = 3.67 ft.
Dist. of - nh = 3.62 ft.
Diff. bet pairs = .05 ft.
or .6 in.
Average dist. = 3.65 ft.

decreased its extension, while the right hind was aided in extension not only by less elevation of action, but a heavier shoe as well.

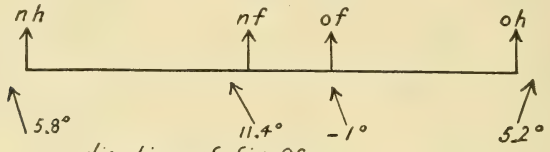
Taking the same conditions of fore, and changing hind shoes, as given in Fig. 99, we bring about a sudden change behind, as given in Fig. 101, namely, we find the left hind more extended over right hind by 0.175 feet, or 2.10 inches, and we also find that right fore is now more extended than left fore by 1.68 inch. Here, again, the heavier shoe on left hind and the longer heel on off hind have shown their effect in extension, the weight increasing same on left hind and the longer heels on right hind decreasing it apparently; but in this case

the breakover at toe of near hind seems to be easier because of its swelled and shorter heels, and its extension may therefore have been easier also; and hence its position ahead of the off hind.

It should not be assumed that the mere increase of 2 oz. on right fore brings about this greater extension; but it should be borne in mind that this right fore paddled a good deal; that is, it swung outwardly when leaving ground and was apt to toe in when landing. The increase of weight simply gave it a better direction and steadiness. Of course, paring the foot by lowering inside toe had a good deal to do with such direction; but if it had not been for the influence of left hind leg with its greater extension that increase of weight on right fore would not have shown up so markedly in greater extension.

In this matter of direction it may be here inserted that the bars of the Memphis shoe, by proper tilting, can be made to accomplish

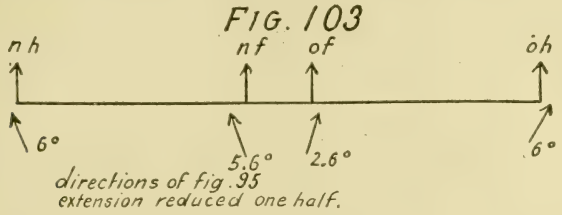
FIG. 102



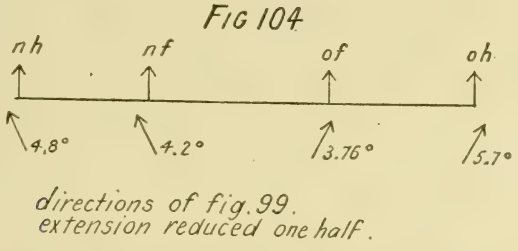
directions of fig. 96. extension reduced one half.

good results in directing the angle of lateral extension, that is, the angle which the foot describes with reference to the median line when a line is drawn or imagined to pass through the middle of frog and point of toe. In other words, the toeing in or toeing out can be modified by such bars. It will be noticed that bars in Fig. 96 are tilted to the right. It was found that this condition aggravated the peculiar directions of the fore feet. While in this case the left naturally toed out and the right fore naturally toed in, these bars made matters worse, as will be seen in Fig. 102, giving the averages of directions and distances with reference to the median line. Here the left fore toes out abnormally (11.4°) and the right fore has its own way about toeing in (—1°). It will be noticed that the minus sign here indicates the opposite direction to that which the right fore should point naturally, namely to the outside.

Fig. 103 will show the directions of shoeing illustrated by Fig. 95, where bars on front shoes were tilted to the left. The error of direction is immediately corrected by such a change, and the right fore now toes out 2.6°. Even the previous shoeing as given in Fig. 99 shows by the directions of Fig. 104 a better line of action in fore feet and here the bars are supposed to be square across the shoe. In sub-



sequent trials with simply a bar across the toe and none at heel the proper correction of the faulty directions of fore was always accomplished by a slight tilt of bar to the left, thus making the left fore break over at outside toe and the right fore at inside toe; that is, the bar with lower end on outside made the left fore toe in or gave it that tendency, and with lower end on inside, made the right fore toe out or gave it that tendency.



Again, it must be remembered that all such directions are aided by the principle of pointing, so ably and fully explained by David Roberge, and that the proper paring of foot with such corrections in view is part of proper balancing.

These various shoeings and results are somewhat suddenly thrust upon the reader without an apparently proper foundation for the principles involved. Later experiments, however, will verify the assertions here expressed. These data at present are but a part of a series

of such investigations and will at least show the difficulties encountered in so intricate a problem as balancing. As the subject unfolds itself before our view it will become manifest that there are certain definite rules which cover certain points in all cases, except such where an abnormal structural fault is beyond remedy for speed or proper action. Were it not true that from these investigations of gaits there were found certain principles whose applications produced certain results in all cases, it would be useless for me to write this book. My object is to generalize, if possible, so that not *one particular* horse under *one particular* man and under *particular* conditions can be improved in gait, but rather that *all* horses under reasonable conditions and treatment can be made to respond to an application of certain principles so generalized.

The example of this particular mare is only one in many where similar difficulties were encountered and overcome by such principles. I do not believe that balancing one horse does necessarily carry with it a great secret of knowledge or of training which does not in some way apply to another horse. While the pride of a trainer may be readily understood, his successful treatment of a case should have certain elements of remedies applicable to all similar cases. Time and observation are the great factors in such remedies. The lapping of one shoeing over another in the effects brought out is another factor to be counted on. We influence locomotion by the shape of foot and shoe. It responds, and yet when another change is made remnants of the previous shoeing are in evidence. It seems but rational that such changes take place gradually and slowly, owing to the fact that by a change we impress the brain and the tissues of the muscles and induce a gradual transformation. Quick remedies are simply impossibilities. If a trainer or shoer strikes it just right by sheer luck or guess it is not entirely due to that quick change, but to the combination of the last change with the still remaining effects of previous shoeings. With gradual changes and such as are based on a rational diagnosis of the case, the remedy is likely to be not only more sure but also more permanent.

This mare, therefore, whose shoeing we have just considered, trotted the trial around the turn under such an influence of a previous shoeing. While the subject had always a habit of carrying off hind forward excessively, the shoeing of Fig. 99, with its resulting extension of Fig. 101, shows the effect of the change from Fig. 98, which latter was entirely faulty and caused the bad way of going behind, as given in Fig. 100.

With somewhat reversed extensions of hind feet in trials following Fig. 99 and Fig. 96 as given in Figs. 97 and 101, it was found that the turns were not so well taken. Hopping, tip-toeing and breaks were more frequent when going at a 2.30 clip, or better. The shoeing of Fig. 96 immediately preceded that of Fig. 95. The shoes of the former were worn from July 5th to July 19th, and the shoes of the latter from July 19th to August 9th.

By the shortening of the heels of the off hind the supposed check to extension is in a degree removed and we find the turn taken better in part on that account. But again, the shortening of both hind by ⅛ inch showed a greater separation of fore and hind extremities by over 5 inches, which in itself means a greater backward extension.

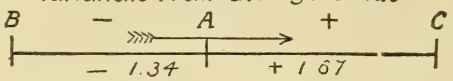
Of course, the change in direction of fore by the different tilting of bars has also something to do with the more even and better gait. But the fact remains that off hind again assumed the greater extension of hind feet, and this with the fact that near fore, in consequence, preceded slightly the off fore gave us the requirement of the preferable extensions at the turn. In other words, the animal indicated that this was the easiest way to take the turns and did it with an even movement of legs.

Elsewhere we saw that the various strides of each leg differ in distances, although all the strides of the four legs must have a standard or average length for that particular way of going. The differences from the averages are the variations and as they fall short or exceed the average they are either minus or plus with reference to that general average. The total difference between the extreme points of such variations may therefore be considered as indicative of the regularity

of the gait. The smaller these variations the more regular the animal is going. It may be illustrated as follows:

FIG. 105

Variations from average stride



A = location of average stride
B A = sum total of variations below average
A C = sum total of variations above average
hence B C = total variations of stride = 3.01

For Fig. 96 we find the calculation of such total variations as follows:

On Straight Course.

n f	o f	n h	o h
(—1.34 + 1.67)	(—2.71 + 1.89)	(—1.48 + 1.91)	(—2.48 + 2.81)
Total 3.01	4.60	3.39	5.29

(average stride = 16.11 ft.)

Under shoeing of Fig. 95 we have the calculations for variations as follows:

At Turn.

n f	o f	n h	o h
(—1.79 + 1.74)	(—1.69 + 1.74)	(—1.97 + 2.07)	(—2.04 + 1.99)
Total 3.53	3.43	4.04	4.03

(average stride = 15.27 ft.)

and for the stretch following the turn:

n f	o f	n h	o h
(—1.32 + 1.27)	(—1.19 + 1.29)	(—1.38 + 1.33)	(—1.42 + 1.22)
Total 2.59	2.48	2.71	2.64

(average stride = 15.84)

The figures given are in feet and decimals thereof.

Comparing the total variations here given we can readily see that the trial on stretch following the turn shows a more even gait and such was the case. In both of the last two instances there is a greater variation in hind than in fore, and as a whole the variations are naturally greater at the turn than on the stretch following it. The last figures,

the result of the same conditions of ground surface, that is, a smooth straight piece of ground slightly downhill, therefore, indicate a marked improvement in action and extension. We see, again, that such total variations have another meaning, namely, that of greater or lesser activity of each leg. For instance, it was found that the greater variations in fore legs belong to the leg that precedes its mate, and the greater variations of hind legs belong to the leg that lags or follows its mate (see Figs. 97 and 94). We shall recur to this peculiar indication of activity later on. Incidentally it may be remarked right here that as a rule greater weight in shoe has a tendency to fold the fore leg more and hence shorten its extension and that with hind feet the opposite is true, namely, the increase of weight will increase extension and prevent high action of the foot so shod. This applies more particularly to one fore or one hind with reference to their respective opposite mates. Of course, it is also to be understood that the shape of shoes and other conditions are alike. This different influence of weight on fore and hind has its cause in the folding of the knee and hock joints and in the general attachment of legs to the body. The fore are more or less rigidly fixed while the hind, though lacking in folding, are more loosely hung from body. A study of the trajectories or curves of motion in the earlier part of this book will indicate the effect of weight on fore and hind; and further proof of this matter will be offered later on.

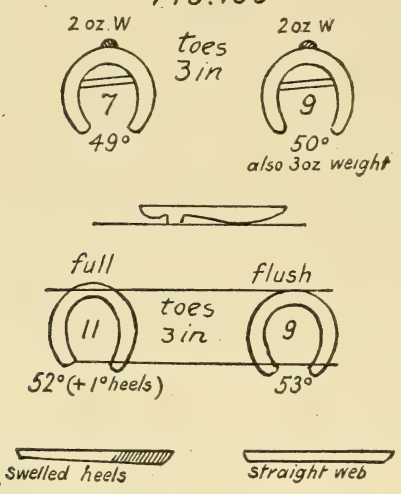
The effect of such a heavier left hind shoe on the animal in question was, therefore, very beneficial to the gait, even though it did not quite eliminate her habit of reaching forward with right hind. In fact, because she did so was evidence that the turn required such a way of locomotion. It should not be forgotten, however, that the minute such uneven extension becomes excessive the benefit is lost and danger from interference arises.

III.—Toe-Weights.

Before investigating this and other cases any further it will be necessary to say a few words about *Toe-Weights.*

The difficulty that many horses have to get around the turn going in the ordinary way—with the infield to the left—is sometimes removed when the turn is taken in the reverse way. It only strengthens my contention for the exact information regarding unequal extensions by means of measurements. It also led me to experiment with toe-weights on both fore and on one fore only. Toe-weights have a very steadying effect on the action, but also often produce too much folding of fore and a resultant deficient action of hind. Their use has been overvalued; but as a means to ascertain deficient extension they have their place. The *accidental loss of a shoe* has often determined such deficiency and

FIG. 106



brought about a great improvement of gait. Likewise the use of one toe weight only has solved the question of squaring the animal's gait. But in all these cases unequal weights are indicators of balance and point to a remedy in foot and shoe rather than to the permanent use of toe-weights. A harmonious action between fore and hind, or an action where the difference is not excessive, should be the aim of proper training. As to a greater extension of fore being due to toe-weights there is evidence to that effect in a trial with the same subject heretofore considered. The shoeing given in Fig. 106 shows a 2 oz. weight on each fore. It is similar to that of Fig. 99, except that the

fore have a bar only across toe (also tilted to left) and the quarters near the heels swelled in the web of the shoe so as to form the same contact with ground as with the double bars. The hind shoes are set a little differently, the near being full, and the off flush at the toe. A week before that the subject was tried with the same shoes, but without toe-weights. The extensions and separations of fore and hind are given in Fig. 107. Always allowing for the increase of separation due to the increase of stride and speed of the second trial, there is here a greater

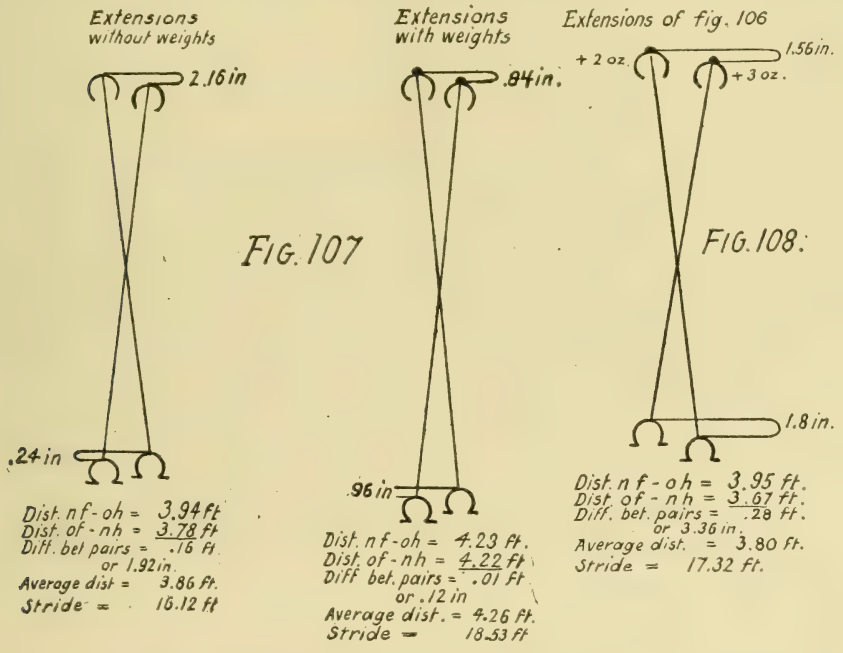

Extensions without weights
2.16 in
.24 in
Dist. n f - o h = 3.94 ft
Dist. of - n h = 3.78 ft
Diff. bet pairs = .16 ft
or 1.92 in.
Average dist = 3.86 ft.
Stride = 16.12 ft
Extensions with weights
.84 in.
.96 in
Dist. n f - o h = 4.23 ft.
Dist. of - n h = 4.22 ft
Diff bet. pairs = .01 ft
or .12 in
Average dist. = 4.26 ft.
Stride = 18.53 ft
Extensions of fig. 106
+ 2 oz.
1.56 in.
+ 3 oz.
1.8 in.
Dist. n f - o h = 3.95 ft.
Dist. of - n h = 3.67 ft.
Diff. bet. pairs = .28 ft.
or 3.36 in.
Average dist. = 3.80 ft.
Stride = 17.32 ft.

FIG. 107

FIG. 108.

separation of fore and hind by 0.4 feet or 4.8 inches (4.26—3.86) a part of which, at least, seems to be due to the toe-weights.

Taking this same case and replacing a 3 oz. toe-weight on off or right fore for the 2 oz., there appears a different extension, as given in Fig. 108; namely, the left fore increases its extension to about 1.56 inches and the left hind leg now shows an increased extension over that of the right hind leg by 1.8 inches. This sudden reversal of extension behind, from right to left hind, is due to the effect produced by the heavier toe-weight on right fore.

These complications may appear to the reader as rather perplexing and confusing, but the reasoning has been borne out by the results in other similar experiments. The toe-weights on right fore by its greater weight—an ounce at the toe equals several ounces in the shoe—has caused the leg thereby to fold more. That is to say, the *action* of right fore is *increased,* and such increase of action communicates itself to its related mate, the left hind leg. This leg responds by a greater *extension;* but the result is altogether bad, because both greater extensions are on the near or left side, making it appear as if the animal had pacing inclinations, which was not true in this case. At any rate, such extensions on one side invite single footing and irregularities of gait.

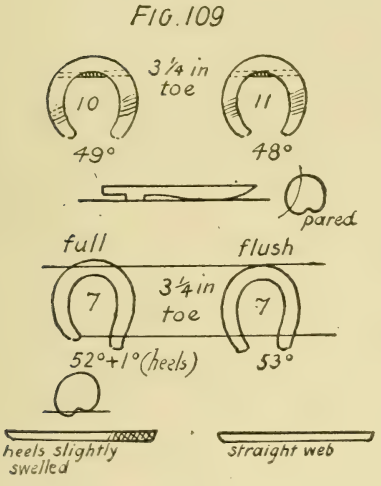
The difference in separation between fore and hind (average= 3.80 ft.) is somewhat less than in Fig. 107 (average=4.26 ft.), where both fore had 2 oz. toe-weights. This is in part due to the lesser speed as indicated by the shorter stride (17.32 ft.), as compared with the 18.53 ft., the stride of Fig. 107. But since all deductions from such experiments for the sake of comparison should be based on the same conditions, it may be well to mention that the trial of Fig. 108 was trotted on the outside of that of Fig. 107 and on harder and smoother ground, the surface of Fig. 107 being somewhat looser. As a rule, all my experiments were made under similar conditions of ground, which was generally cross-raked by hand to a fair looseness such as exists on a well prepared track.

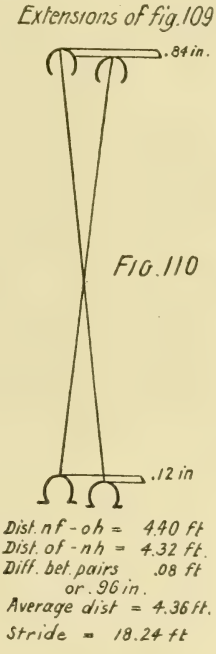
The subject which we have been considering was a mare with much knee action and a hind extension that interfered with the fore, causing forging and scalping. Besides that she paddled with the right fore. She has a record of 2.24¼, but has trotted much faster.

Several more trials were made with toe-weights on either fore to ascertain their effect and the shoeing of three weeks later, as given in Fig. 109, was the basis to work on. The principal feature of this shoeing is the lighter and equal weight of hind shoes and the longer inside heel of shoe on left hind to counteract a longer outside heel in hoof as given.

The reader may ask here, as well as in previous cases, Why this

difference in angles and weights in all these shoeings? It should, however, be remembered that these shoeings were taken out of a long series, the purpose of which was the establishment, if possible, of certain general principles; but to satisfy the queries that may arise in the mind of the reader who is anxious for practical results I will indicate a few reasons. These do not, and cannot at this stage, constitute such generalizations as arise from many cases tried under similar conditions. Gradually certain facts were sifted out from the

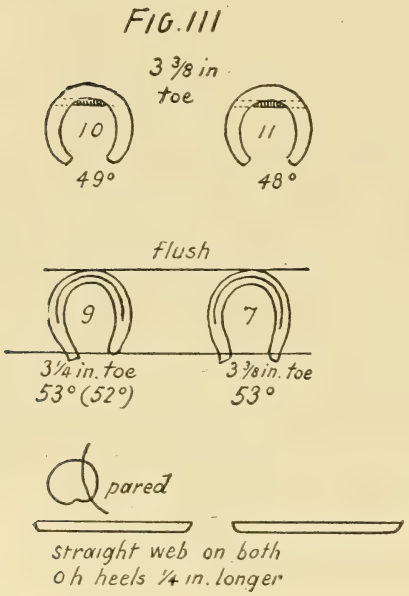


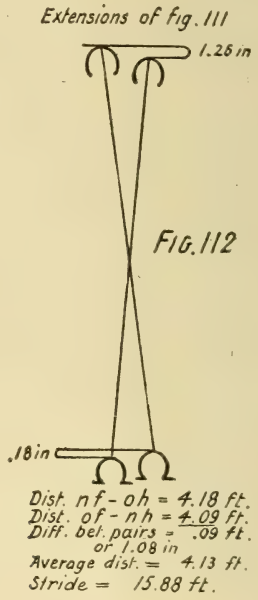

Extensions of fig. 109
.84 in.
FIG. 110
.12 in
Dist. nf - oh = 4.40 ft
Dist. of - nh = 4.32 ft.
Diff. bet. pairs .08 ft
or .96 in.
Average dist = 4.36 ft.
Stride = 18.24 ft

various changes and these will become apparent later on. For the present the reasons for such shoeings will be given as they appear to be warranted by the object in view, namely, the correction of faulty gaits. Only by numerous changes can such experiments yield the desired information for practical purposes.

In Fig. 111 there appears again a heavier shoe for the right fore. It was done in order to counteract that paddling foot, to give it a better direction. The lower angle has in view a better extension. Behind there appears a heavier shoe on the left foot so that the ex-

tension may be increased. Weight always increases action, more so in front than behind; but whether that increase of action will be in elevation only or also in extension depends to some extent on the shape of the shoe. It is similar with the different lengths of toe or foot. Other things being equal, the longer leg in front (⅛ or ¼ inch) acts as a stilt for its opposite mate, lifting the latter and giving it easier extension. It is in the nature of the more rigidly fixed front legs. But again, other conditions being equal, the longer foot behind (⅛ or ¼ inch), will be greater in extension than its opposite mate. It is reason-




Extensions of fig. 111
1.26 in
FIG. 112
.18 in
Dist. nf - oh = 4.18 ft.
Dist. of - nh = 4.09 ft.
Diff. bet. pairs = .09 ft.
or 1.08 in
Average dist. = 4.13 ft.
Stride = 15.88 ft.

able to suppose so even at this stage of our observations because of the different and looser articulation of hind legs.

Later on this will become more apparent. At any rate, the shoeing of Fig. 111 was based on the erroneous presumption that simply longer heels in one hind shoe will cause it to point back, or, in other words, will check its extension. The main point here raised was whether the right hind foot with its greater length over that of left hind foot would tend toward a greater extension and therefore toward an easier taking of the turns, the supposition being that the greater sweep of the right

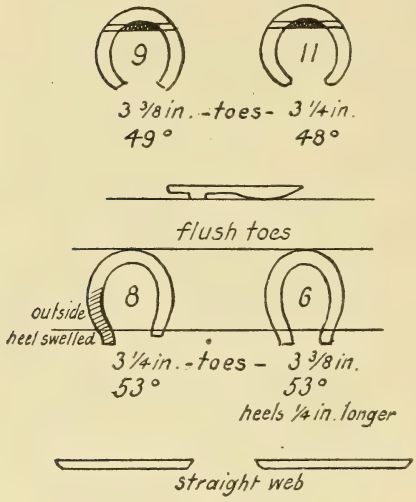
hind necessary at the turns could thus be accomplished, as well as by a slight lean to the left side, which would naturally be effected more easily by this slight increase in length of outside leg or foot. All in all, however, this adjustment of the hind shoes effected an equalization of hind extension; for, the near with its heavier shoe and shorter toe may be considered to offset the off with its lighter shoe and longer toe plus its longer heels, so that the effect of the last two conditions—longer toe and longer heel—was somewhat modified by the counteraction of the near hind. Subsequent investigations will make this more clear.

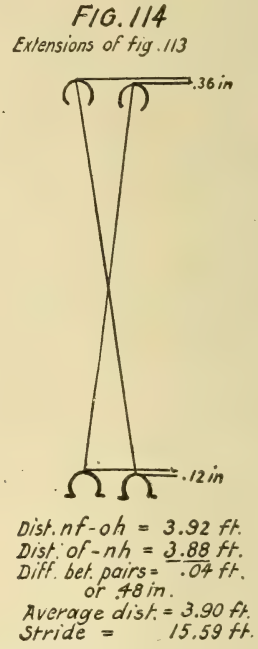
It will also be noticed that the toes of fore are longer in Fig. 111 than they were at previous trial of Fig. 109. This was due to the fact that hind shoes only were new, the front shoes remaining on, showing as usual the continual growth of foot, a fact against which David Roberge warns by saying, *"the growing foot is a growing evil."* But sometimes a little increase in length of toe enables the animal to move better and faster. The trial proved satisfactory and a subsequent mile in 2:27 in a vigorous, smooth fashion was a pretty fair result.

At this trial the stride averaged 15.88 feet and the variations for each leg from this average were comparatively smaller or of lesser extent than at the trial of shoeing given under Fig. 109, where the average stride was 18.24 feet. The greater the speed and the longer the stride in consequence, the less are the variations of the strides of each individual leg; but the faults of gait, though less perceptible, are still there under cover of great exertion. The intermediate speed is, therefore, more preferable, not only for detecting faults, but also for correcting same. Allowance must, however, be made for the greater effectiveness of any remedy applied and tested at great speed. We must try to administer homeopathic or small doses only for extreme speed.

In order to further see the effect of different lengths of feet, the shoeing of 18 days after that of Fig. 111 is shown in Fig. 113, with position of feet expressing their extensions in Fig. 114. There is a decrease in extension of left fore due to forced extension of right fore by means of a shorter foot with reference to left fore. Partly in-

fluenced by right fore and by the two ounces more in weight of shoe the left hind advances slightly in extension, making a greater extension by a fraction of an inch; and compared with previous trial it advances over the right hind by 0.18 + 0.12 inch or 0.3 inch. All such small differences are negligible and are only given as actual differences of averages of 20 strides. No matter how small, they are nevertheless exact indications of conditions.





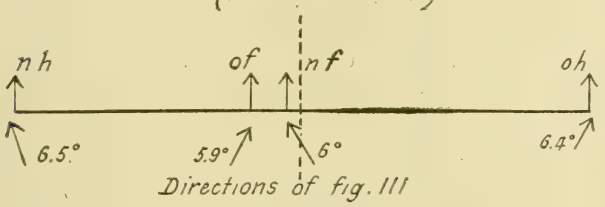
To show the effect of the swelled outside heel of the left hind shoe the comparative lateral extensions and angles of feet with reference to the median line are given in Fig. 115.

The left hind by means of this outside swelled heel is forced to a greater angle, thus showing the effect of the shape of the shoe, besides indicating a greater spread of hind feet by about 1/4 inch on the average of 16 strides. It will also be noticed that the fore travel on practically the same line in both trials. In the first trial they cross over, and this is due to the fact that the animal carried her head a little to left side, thus giving the right and paddling fore a chance to land on the inside of its natural line of motion.

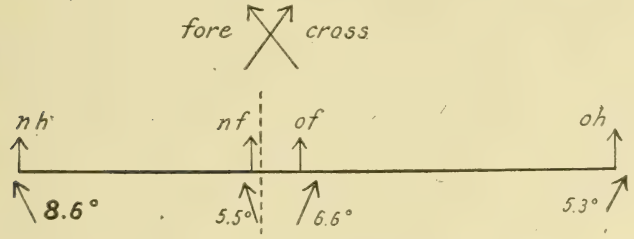
Though side poles and rods are unsightly affairs in a race much may be effected by their judicious use in training out such a habit. No horse can be balanced unless going straight. Such a straight direction may be brought about by shoeing in time, but a quicker course is to use a side rod in conjunction with such investigations as these.

This carrying of head to near side always had the effect of a slight increase of near hind extension. It generally happened when driven close in to the fence and an allowance has to be made for that in the result. Hence the shoeings here given do not show as yet conclusively

FIG. 115
(reduced one half)



Directions of fig. 111



Directions of fig. 113.
Dotted lines are median lines

the principles involved. For instance, the longer foot on right hind may at times show a greater extension because of such a length and also because of such a tendency of that leg and thus offset the extension of left hind due to this carrying of head to left. All these experiments, therefore, should be considered in that way and they were, in fact, but steps in the direction of equal extensions.

Elsewhere it has been emphasized that time is an important element of balancing, and in all trials for such investigations it has been invariably found that when they follow too closely upon a change of shoeing the result is confusing and not indicative of the true effect of

such a change. An instance of this was demonstrated by the shoeing following Fig. 109, namely, that of Fig. 111, where, within four days, a trial was made and the results were not as satisfactory as they were ten days after that.

Let us now return to the effect of toe-weights. The apparently balanced condition of Fig. 111, which produced a good and smooth mile, was used for such a possible demonstration of the effect on either fore foot.

In my remarks on toe-weights it was maintained that while they caused an increased action or folding in front, they were apt to bring about a deficient action behind. Many trotters loaded down with toe-weights in front show a low action but apparently increased forward extension behind. Toe-weights, therefore, never appealed to me as being instrumental in causing a better equilibrium of fore and hind action, so pleasing to the eye, but seemed rather to aggravate matters. The high elevation and somewhat increased extension of fore does influence the activity of hind legs, but there seems to be not, as we should expect, a higher elevation of action, but rather an increased forward extension. The use of toe-weights, therefore, does not separate fore and hind, but seems to be productive of closer approach, so that the claim that they will make the fore feet keep clear of the hind by greater separation of fore and hind has not been proved, although by the greater folding of fore these are apt to be out of reach of the hind when the latter reach forward.

For the good name of the trotter—as being something better and worthier than a mere racer—we cannot sacrifice everything to speed alone. We must have splendid action, well balanced action, evenly distributed action; in short, action of the vigorous and the useful kind combined. Toe-weights applied continually do not promote such action.

With the shoeing of Fig. 111 and the subject driven on outside of the first trial, which was without toe-weights and near the fence, it was noticed that the head was carried straighter. The third trial on outside of second was made under same conditions. The extensions of each trial with toe-weight on alternate fore are given in Fig. 116 and Fig. 117.

Here we have a recurrence of the tendency of right hind to excessive extension, due no doubt to the application of the toe-weight on the left fore, which caused the latter's increased action, and by sympathy with the right hind, also the greater extension of both. Again, the averages of 20 strides and relative positions of feet tell of the average discrepancy as presented in Fig. 116. In all the diagrams of extensions the scale has been ½ inch to the foot, but the differences

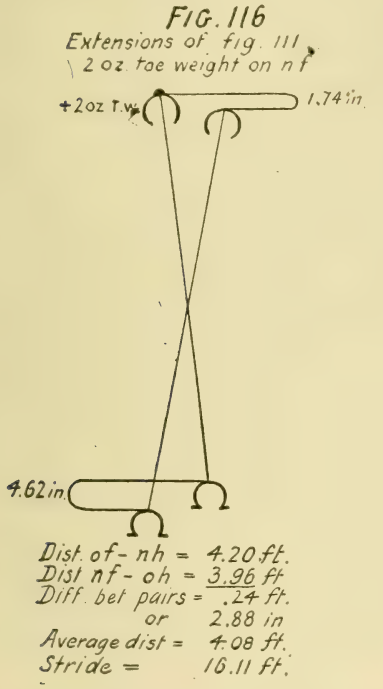


FIG. 116
Extensions of fig. 111
2 oz. toe weight on nf
+2oz t.w.
1.74 in.
4.62 in.
Dist. of - nh = 4.20 ft.
Dist nf - oh = 3.96 ft.
Diff. bet pairs = .24 ft.
or 2.88 in
Average dist = 4.08 ft.
Stride = 16.11 ft.

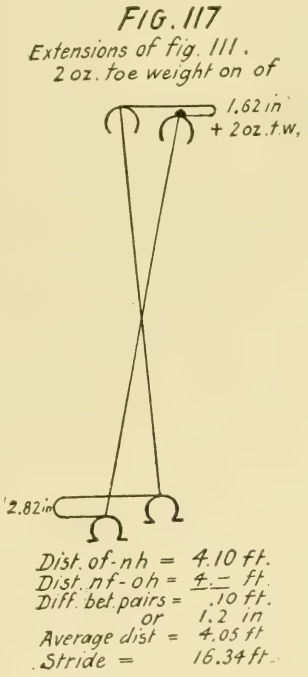


FIG. 117
Extensions of fig. 111.
2 oz. toe weight on of
1.62 in
+ 2 oz. t.w.
2.82 in.
Dist. of - nh = 4.10 ft.
Dist. nf - oh = +.- ft.
Diff. bet pairs = .10 ft.
or 1.2 in
Average dist = 4.05 ft
Stride = 16.34 ft.

of extensions are conventionally excessive or in disregard to that scale in order to make them more palpable and visible to the eye.

Now, turning to Fig. 117, we see a change of extension, or rather a diminution of the former extensions caused by the toe-weight on the off fore. There is a slight increase in length of stride, amounting to about 2¾ inches, and that in itself may account for the slight decrease of the average distance between the pairs of legs, from 4.08 feet to 4.05 feet. But what is more remarkable is the greater approach of equality between the two distances. I have always held it to be of

importance that such distances should be as near alike as possible in order to have a square trot and an even action. Whatever unequal extensions there are, they should be found in both fore and hind feet and should be of equal or nearly equal magnitude. Such an approach to equality is found in the application of the toe-weight to the right fore. The left hind responded to the greater activity of the right fore. Both the left fore and the right hind receded in their previous extensions and by comparison the two cases exemplify the effect of a toe-weight not only on the foot bearing it, but also on its correlated hind mate. The excess of extension of left fore drops only from 1.74 inches to 1.62 inches, or 0.12 inch, but that of the right hind decreases from 4.62 inches to 2.82 inches, or 1.8 inch, making a total approach of n f—o h of 1.68 inch (2.88—1.20).

Toe-weights, therefore, have their uses, especially as auxiliaries to establish evidence of excessive and wrong extensions by applying them singly to either fore foot. I would recommend such a test as a rough and quick, though an indefinite, short-cut to balance. As mentioned before, a shoe accidentally lost in a try-out has often served the same purpose to the thoughtful trainer, and a cast shoe with better gait and speed in consequence is a hint with a vengeance to any observer. It should certainly call forth the simple little question. "Why?" upon whose repetition so much enlightenment rests. We are surrounded by many mysteries, but this little question has a right to knock at the door of every one of them, and no human tradition, or prejudice or authority, shall forbid it to do so, for upon that right all true progress depends.

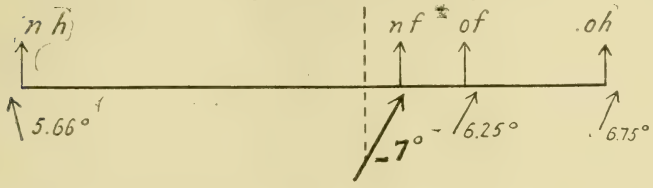
Just as a cast shoe may reveal an inequality of length in foot or leg, so a toe-weight applied to one fore foot may point out a deficiency of extension; but whatever the supposition, do not let us speak of a horse striding shorter with one leg than with the others. A horse would not trot or pace if he did that continuously.

Let us again consider the effects of toe-weights and examine other cases.

Let us take the case of a mare with a vicious direction of near fore, as given in Fig. 118. The near fore foot crosses over the me-

dian line and toes in 7°. Her gait was unsteady in front; she tried to recover her deficient forward extensions with one or the other fore leg. It was only a case of brief consultation, and, therefore, unsat-

FIG. 118
Directions of feet
(reduced one half)



isfactory for any definite improvement. She was shod about as given in Fig. 119, and in Fig. 120 are seen her extensions. For the exactness of angles of feet or length of toes, I could not warrant, because there

FIG. 119

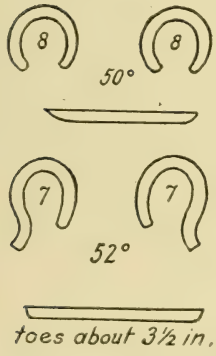
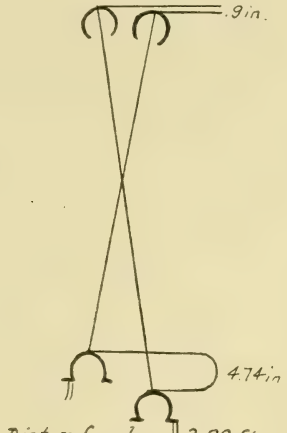


FIG. 120
Extensions of fig. 119.



Dist. nf - oh = 3.98 ft.
Dist. of - nh = 3.51 ft.
Diff. bet. pairs = .47 ft.
or 5.64 in.
Average dist. = 3.72
Stride = 14.88 ft.
outside heels Slide
3 to 4 inches

was not another chance to try her. She was a very fair type of trotter, standing perhaps a little close together with fore and a little far apart with hind, and also standing slightly under in front but fairly straight

behind when looked at from the side. She was rapid gaited and had little knee action. Besides, she was unsteady behind and the outside turned heels of hind shoes slid on ground from 3 to 4 inches. Any such concussion cannot possibly benefit the gait or balance. I recommended the use of a 2 oz. toe-weight on *near fore* only as a test, and the removal of turned heels behind. While she had shown a mile in 2:22 with much effort, she went a smooth and easy mile in 2:18½, her fastest time then.

When examining the extensions in Fig. 120 we should remember also that off fore was more or less held back by interference with the near fore. For, as could be expected, by its being placed towards the off fore, the near fore was now and then struck at the knee by the off fore; and this interference held back or checked the extension of the off fore. The toe-weight remedied this somewhat. It steadied the near fore, gave it a somewhat better direction and possibly better extension, and by such increased activity it also influenced its diagonal mate, the off hind; so that, all in all, the effect of that toe-weight was the same as in the previous case. I regret that the result so obtained by advice could not be brought down on paper as the other cases, but the evidence remains that a 2 oz. toe-weight so applied and under such conditions improved both gait and speed. Included in the advice given was the usual and always effective rule of pointing advocated by the late David Roberge, to the effect that the near fore was lowered on inside toe and the "wing" of that hoof reduced at that point. The result was that she quit banging her left knee.

Two more of these fleeting cases came to my attention, where toe-weights showed the same general effect. In both cases the attitude of the animal was very faulty because the front and the hind legs stood under; that is, there was a pointing back of fore and a pointing forward of hind feet. Such an attitude always causes trouble and disappointment from the fact that interference is almost impossible to overcome. The animal may have ever so much speed and ambition or trotting instinct, but Nature having put up a poor structure for speed balks all efforts. We can, however, modify even such an attitude in time so that the animal can at least trot well enough to get into the

list of 2:30 performers. Subjects so constituted are very refractory to treatment and the problem of separating the extremities is a difficult, though not impossible job. Without time there is no remedy for these at all, for horses of such an attitude have naturally a slovenly way of poking their hind feet straight under without any effort at elevation. They are inclined to single-foot when there is effected a marked change in the shoeing of hind feet.

In these cases I lack the evidence of consecutive shoeing and therefore cannot offer quite as conclusive a proof of the effect of the toe-weights used, and I must ask the reader's kind indulgence in the matter.

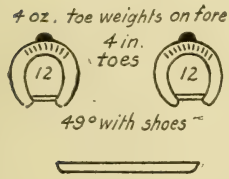


FIG. 121

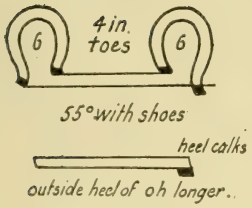
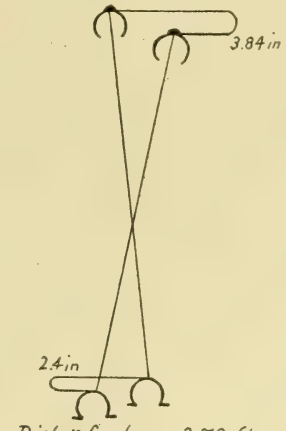


FIG. 122
Extensions of fig. 121



Dist. nf-oh = 3.72 ft.
Dist. of-nh = 3.60 ft.
Diff. bet pairs = .12 ft.
or 1.44 in.
Average dist. = 3.65 ft.
Stride = 14.95 ft.

In Fig. 121 we have the shoeing of one case, a mare, by Steinway, of which angles were measured with shoes on hoof. Both fore carry 2 oz. toe-weights and bars across heels. The web of the shoes was wider at toe than at quarters, being heavier at toe in consequence. With this double weighting of toe the heel impressions of fore feet were hardly visible on ground. The hind feet were very steep in angle, besides being checked in extension by long outside heels and calks.

The whole method was meant to force the separation of fore and hind extremities. This was done at the expense of the length of stride, which is here but 14.95 feet. The gait was rapid but stubby. She used to have a longer and more sweeping stride when allowed to get under herself with hind feet; but during this shoeing she improved with *toe-weight on near fore only.* She took the turns better, the first quarter in 35 seconds and a mile in 2:21, her best mile then. This toe-weight increased the activity of off hind, counteracting the longer heel, which was meant to give it better direction and to check its extension. The toe-weights on both fore distributed their influence on both hind and at the turns the off hind did probably not extend enough to effect proper

FIG. 123

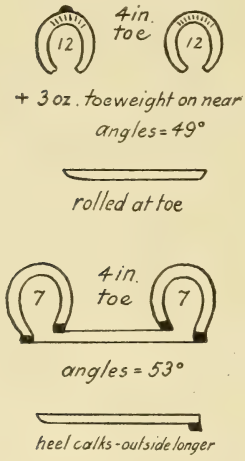
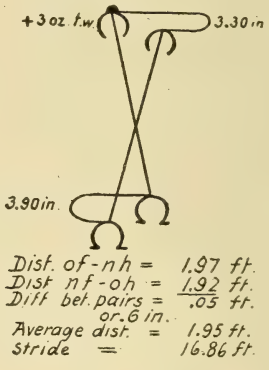


FIG. 124

Extensions of fig. 123



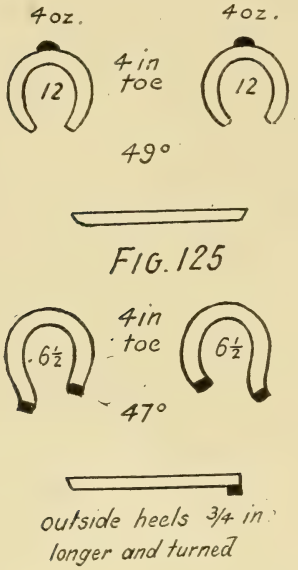
propulsion. When near fore only was weighted a better extension of off hind was effected by the greater action of near fore. This led me to have her shod, as given in Fig. 123, the shoeing being almost identical with Fig. 121. The hind shoes were 1 oz. heavier each and the heels were made alike on outside of both shoes. Besides, to overcome the rapidity of stride the angles of hind were let down about one degree. In the former shoeing the angle was taken with the shoes on, but hind calks had somewhat worn, so that between that measurement and this one on hoof directly made a difference of about one degree less for last shoeing.

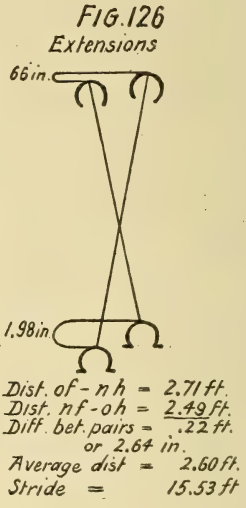
Tried this way the result is curious. My notes say that "she now shows good knee action, but no hock action at all." Evidently the hind legs again extended under too much. Fig. 124 made on the same scale as Fig. 122 will show by comparison with latter this lack of separation between fore and hind extremities. There is, in fact, a decrease in the difference of extension between fore (from 3.84 inches to 3.3 inches), but behind the difference has increased considerably (from 2.4 inches to 3.9 inches). It is the off hind that advances over the near hind. The average distance between the extremities is but 1.95 feet against 3.65 feet at previous trial. It is true that stride has almost increased 2 feet (from 14.95 to 16.86 feet), but this in itself should rather cause greater separation. There is also the beveled toe of fore to consider as increasing the knee action and decreasing somewhat the extension of fore. The old habit of going under herself behind was, therefore, again brought out and this double approach of extremities caused the abnormally small distance between them (1.95 feet). Amid these many conditions, however, there appears again the effect of the toe-weight on the activity of the hind leg correlated with the fore checked by such a weight. The slight changes here undertaken showed a remarkable difference in the mode of propulsion. It only goes to prove that we never know the actual conditions of a horse's gait until it is plotted down in such a manner. Again, the reader is advised not to take this as conclusive evidence of other matter than the question of toe-weights, which seem to have shown their effect in the above cases.

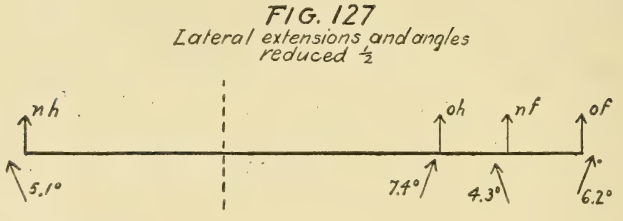
The second case, and last one in this series, was that of a trotting bred gelding by Direct, which had been used under saddle and was a compact, handsome animal. His gait was, like the previous one, more or less the result of a continued application of toe-weights, long toes and low angles. Such combination of unfortunate circumstances, for which man is always responsible, are not matters of a few shoeings for correction. One year would be about the time necessary to effect any change without loss of speed.

This gelding was shod as in Fig. 125, with resultant extensions lengthwise and lateral as given in Fig. 126 and 127. With the toe-weights his manner of going was fairly good except that he went under

too much behind. The test with the median line and angles with same brought out a direction of feet that was probably acquired when under saddle. Fig. 127 presents a peculiar bunching of three lines of direction with the near hind away by itself. It was an extremely faulty position and one calculated to give trouble. In consequence the angles of feet as placed upon the ground were greater on the off side than on







the near side. Suspicion of inclination to single-footing showed up in the greater extensions of both right fore and right hind. In the pure trot this habit rarely appears and if it does it predicts pacing tendencies, either natural or due to shoeing. The low angle behind (47°) favored a forward extension, so that the average distance between extremities (2.60 feet) was out of proportion to the average stride of

15.53 feet; even though the horse stood under at both ends more than he should. His gait and action were rather rapid and not high.

In the variations from the average stride—that is, the difference of individual strides over and below the average—the fore showed 23 per cent. more unsteadiness than the hind. This proves the forced and bad effect of toe-weights in this case, quite the contrary to the effect they had on the previous case of the mare, where the variations were small and fairly evenly divided among the four legs. The gelding's variations were as follows:

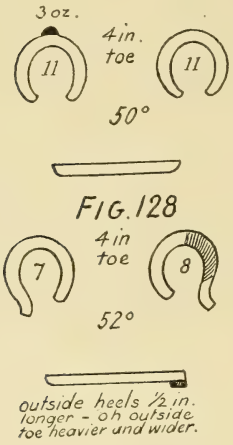
n f	*o f*	*n h*	*o h*
+4.11—6.83	+5.98—6.55	+4.55—3.78	+4.99—3.09
	total scope		
10.94	12.53	8.33	8.08

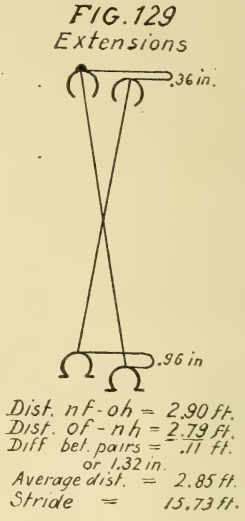
It is evident from this that he labored with fore, as was actually the fact. Here was, therefore, an effect of toe-weights that was undesirable and faulty. Under the shoeing of Fig. 125 they did not benefit him. The shoeing was the trainer's own idea and the trial was made under conditions as found.

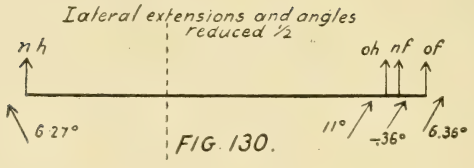
Later on, when the trial with one toe-weight only was made with the mare, this gelding should have had the single weight attached to his *off* fore instead of to his *near* fore. The shoeing was then changed somewhat, as can be seen in Fig. 128. There is practically no change in this except the angles of hoofs, particularly of hind ones, where angle was increased to 52°. The object of this was, of course, to check the extension of the hind legs. The result shows such an effect, namely, the separation instead of being an average of 2.60 feet is now 2.85 feet, or a gain of 0.25 foot or 3 inches. The difference between the distances of the two pair of legs is also less (0.11), just one-half of that of former trial (0.22).

There is here also the effect of the toe-weight in the greater extension of near fore by one inch over that of previous trial, Fig. 126 (0.66 + 0.36 = 1.02 inches); but the desired effect of this toe-weight upon the off hind is not visible. In fact, the relative positions of hind feet is the opposite to what it was in Fig. 126. Looking at the lateral extensions of Fig. 130 we find them all less than in Fig. 127,

and the reader will notice the abnormal large angle (11°) of off hind, which is the effect of the shoe employed. The intended effect of such a shoe, namely, that of carrying the leg out, was not attained. We still have the annoying position of same inwardly of off fore, with the fault of excessive pointing out with toe which is caused by shoe. This means that the foot was more or less checked in extension and dragged along, with a resultant closing up of entire separation be-







tween the feet crosswise. Besides this we have a peculiar toeing in of the foot carrying the toeweight, which is in part due to the direction of off hind foot. Such an inward direction of the near fore, or rather such a direction to the opposite side of its normal direction, makes the total result doubly faulty. These directions may be entirely due to faulty paring of feet, which is so an essential matter in pointing, and often has been proved so in other experiments more directly under my control. At any rate, we have seen the effect

of the weight on near fore, though through other conditions its effect on hind action was not visible. Loping under the saddle had probably affected this gelding's open trotting action and inherited pacing tendencies may explain the extensions of two feet on one side (Fig. 126) instead of on the opposite side, as in the true trotting action. Even with this faulty gait he could show miles in about 2:25, the near fore extension favoring an easier taking of turns.

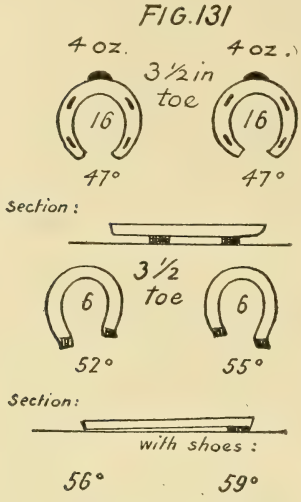
It should be added that in this experiment the variations of strides from the average were far more regular and even than in the previous trial, the fore being but slightly more irregular than the hind, although the off side (right fore and right hind) gave about 20 per cent. more irregularity than the near side, showing again that the interrelation of legs had an element of the pacing or single-footing habit, either inherited or acquired by the saddle.

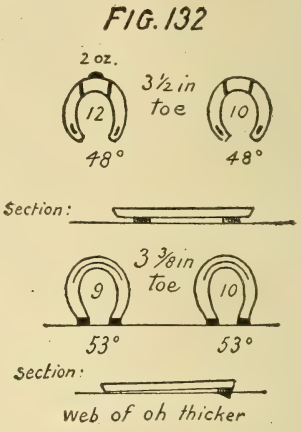
A few more experiments would have shown whether his gait could be improved at all and whether he was really worth training or could only be a good saddle horse or roadster. Here it is where the deception comes in and horses are kept in training that are not worth the money spent because of structural or acquired faults almost beyond remedy. They are speedy, honest and level-headed, but simply cannot strike an even, regular clip to accomplish what is asked of them. One thorough insight into their mode of locomotion will not only tell us of the impediments, but save us a whole lot of trouble and the energy lost in continuing the training by hoping against hope and trusting to luck.

Let us take, for instance, the usual refuge to toe-weights when the fore feet do not seem to "get away" or extend. There was a horse by McKinney which I was supposed to immediately benefit and correct in two shoeings. Fig. 131 will give the reader a good conception of the usual overloading of fore feet.

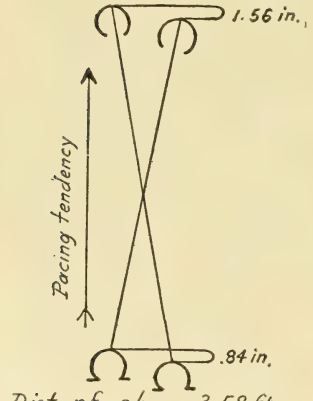
This animal presents one of the many cases where action is naturally rapid, but where it is straight up and down rather than extended. As illustrated in Figs. 20 and 21, action may be increased in elevation by means of weight — in this instance by toe-weights *and* heavy shoes — but it is not always a guarantee for *increased extension.*

With a horse that has naturally somewhat of a forward reach with



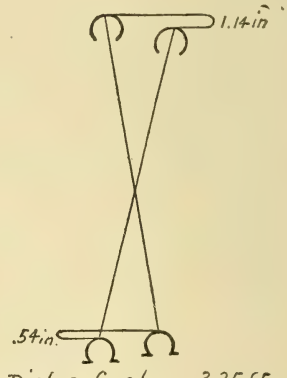


Extensions:



Dist. nf-oh = 3.58 ft.
Dist. of-nh = 3.38 ft.
Diff. = .20 ft.
or 2.4 in.
Average = 3.49 ft.
Stride = 14.2 ft.

Extensions:



Dist. nf-oh = 3.35 ft
Dist. of-nh = 3.30 ft.
Diff = .05 ft
or .6 in
Average = 3.32 ft.
Stride = 14.01 ft

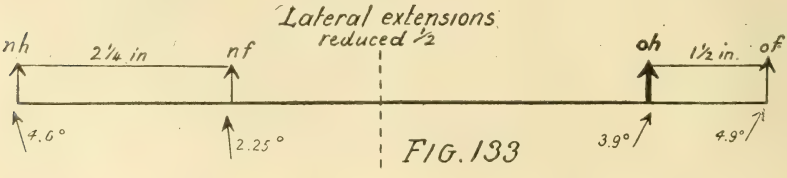


FIG. 133

fore feet the application of weight would act as shown in the curves of Fig. 19, but where by a quick muscular contraction the front legs have a jerky action, weight seems to aggravate such action. It would, therefore, take a great deal of weight to effect a slight increase in extension. And again, having increased such front action, we are apt to see the animal go very low behind; so much so, in fact, that the heels of hind shoes will slide a couple of inches. Such a contact with the ground cannot in any way give the horse any improvement of gait. There must be no sliding of shoe or any unusual or unequal concussion with the ground visible in the foot prints.

The off hind in this case was carried inside of off fore slightly, as will be seen in the next trial of Fig. 132. Here we have again an effect of the toe-weight applied to the near fore foot only, which effect for extension was somewhat counteracted by the increased weight of shoe (12 oz.) For, with such an action as this horse possessed the effect of weight in shoe will be in elevation more than in extension. Hence the light toe-weight on near fore foot did not extend that foot as much as anticipated, but it did influence the off hind in a measure.

The off hind has a shoe with a little thicker web (1/16 inch) on account of the lack of extension of that leg at the previous trial. The additional ounce does not in itself make the change in its extension, but this slight change *and* the influence of the action of toe-weight on the near fore have the desired effect of regulating the distances of the correlated feet, making these practically the same. (3.35 — 3.30). There was less sliding of hind heels, even though the stride was the same and the distance between fore and hind feet was *less*. (3.49 — 3.32 = 0.17 ft. = 2.05 inches.) Here we have the true trotting extension, that is, the diagonal feet instead of the lateral ones extend together, and in consequence we have a diminished tendency to single-foot which existed previously. Incidentally attention should be called to the inaccuracy of shoeing by the eye only, for the difference of angles of hind feet (Fig. 131) is an error that a hoof gauge would readily detect. Such differences

will make a horse badly gaited and often produce faults hard to eradicate.

As to the lateral extensions (Fig.133) it may be noted that the off hind did not have a good direction. In fact, it was found later that it had the tendency to overreach and, as is so often the case, the direction changed from outside to inside of off fore. Such cases as this one cannot be mended by a few shoeings. Owners too often expect the shoer to do wonders when, piled up in the mechanism of the horse, there lie the various cross-purposes of all sorts of previous changes, which one definite plan continued for a long period alone can eradicate.

In considering the effects of toe-weights we have, therefore, seen that in a general way they give direction to the fore feet and increase their action and, to some degree, their forward extension; but their influence is also felt by the hind feet and these are drawn forward rather than upward so that their extension is also affected. That is to say, unless shoes are used which by their shape increase the elevation of hind action, the hind forward extension is visibly increased by the use of toe-weights on the fore feet. We may therefore have the spectacle, so often observed, of a horse cleaving the air with splendid but excessive front action followed by "daisy-cutting" hind action, but hind action that gets under rather to excess. If we were to judge efficiency solely by speed, then the trotter with long toes, low heels, three ounce toe-weights on each fore, heavy elbow boots, a sky-scraping nose on a head stiffly propped up by an unyielding checking device and with light plates on hind feet, and a mere shuffle for action behind, but withal able to trot in 2:07, or better, would be a horse of almost ideal perfection. "There you are, gentlemen, can you beat that? Otherwise don't criticise!" the trainer will probably say; and with mere speed as a test, or as a standard to judge by, the gentlemen addressed will bow their heads in silence or raise their eyes in wonderment, as their individual feelings may direct.

With good will toward all, but especially with a view toward raising the real efficiency of the trotter and the pacer by making of them animals with a free and easy motion and with a well proportioned

action between fore and hind so pleasing to the eye, the writer urges the use of toe-weights only as a temporary remedy and as a means of educating the animal to a steadier way of going, but to be replaced, if possible, by a different method of shoeing. Toe-weights with a resultant better gait serve as indicators of faults of extension and as such they are a ready help to a proper balance; but as permanent attachments to the foot they can only be condoned when everything else fails to effect that balance. To the spectator, or the general public, who expect to see finished graduates from the training school appear in the contests for supremacy in speed, such paraphernalia as toe-weights, cumbersome boots and bandages, hopples, Raymond or similar head supports, all appear highly artificial, forced, unnecessary and detracting from the real efficiency of the horse. The only appearance of the horse at such contests of speed that will insure general approval should suggest efficiency by simplicity and beauty. No one knows better than the trainer how difficult it is to effect such a combination as efficiency, simplicity and beauty. Wherever and whenever he has done so, a prompt recognition of his great ability has been accorded him for the solution of so difficult a problem. That has been and should always be the eminent endeavor of the American trainer and on it rests not only the popularity and reputation, but also the continuous improvement and evolution, of our American standard-bred horse.

IV.—Knee and Hock Action Regulated by Weight and Shape of Shoes.

Following the remarks on toe-weights, and before the effect of equal and unequal weight is entered into, it might be well to recall the instantaneous pictures of Muybridge. That quartet of trotters, Occident, Elaine, Edgington and Clay, will furnish some interesting and instructive data concerning the comparative elevation of both front and hind feet, as well as of knee and hock joints.

In judging such elevations it should be remembered that the hock joint is normally located a little higher than the knee joint and that

the flexion of the hock joint cannot be as easily and as completely accomplished as that of the knee joint. The very fact that it is the reverse of the forward flexion, with its angle toward the direction of motion, tends to show that the effort of flexing cannot be so long and so fully sustained as in the knee. The respective compensations in the legs and their attachments are worth noting. The comparative rigidity of shoulder is compensated or corrected by the ready flexibility of fore leg, and on the other hand the comparative stiffness of hind leg is compensated or corrected by the greater looseness or mobility of the hip bone or femur. These differences in flexion have as a consequence corresponding differences in elevation of the hind and fore feet. Action proper, however, is determined by the elevation of the knee and hock joints because these are not only prominent points in locomotion, but they are also more easily and readily located by the eye.

To exemplify such a comparative elevation we need only appeal to the facts or deductions from the famous pictures of Muybridge. In Fig. 134 such comparative elevations are illustrated for each of the four horses previously considered. The curves here are only conventional arcs of a circle and are meant merely to indicate the scope of action and not its precise movements, the latter having been investigated and shown before. It so happens that the points of elevation of these joints and feet were measurable by forty-eighth parts of an inch and such was the standard taken to get the proportions. But in order to make everything more visible Fig. 134 was made on double that scale, or twenty-fourth parts of an inch, and as in the former standard so also in this: five parts made up one foot as given on the photographs. The accuracy of the illustration depends on that of the pictures as reproduced; but they are, upon closer examination and after making allowance for blurs, very good attitudes from which to deduce these results. The horse Occident having the highest knee action, which rose to 15, gives us the extreme from which we derive the various proportions. We should bear in mind that the hock joint stands higher than knee joint, and in these pictures the latter is about 80 per cent. of the height of hock joint, this

proportion holding good in all of the four subjects, even in Occident,

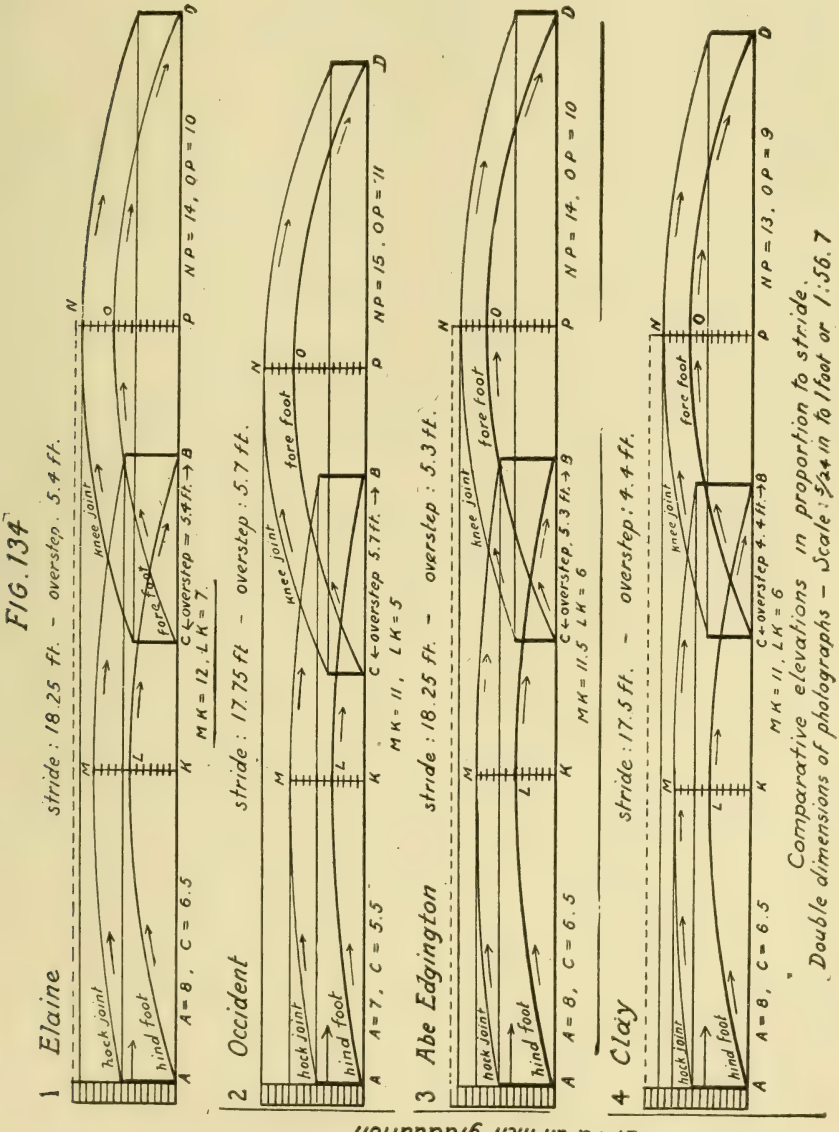


FIG. 134
1 Elaine stride: 18.25 ft. - overstep. 5.4 ft.
2 Occident stride: 17.75 ft - overstep: 5.7 ft.
3 Abe Edgington stride: 18.25 ft. - overstep: 5.3 ft.
4 Clay stride: 17.5 ft. - overstep: 4.4 ft.
hock joint
hind foot
knee joint
fore foot
A = 8, C = 6.5
A = 7, C = 5.5
A = 8, C = 6.5
A = 8, C = 6.5
M K = 12, L K = 7
M K = 11, L K = 5
M K = 11.5 L K = 6
M K = 11, L K = 6
C ← overstep = 5.4 ft. → B
C ← overstep 5.7 ft. → B
C ← overstep, 5.3 ft. → 9
C ← overstep 4.4 ft. → 8
N P = 14, O P = 10
N P = 15, O P = 11
N P = 14, O P = 10
N P = 13, O P = 9
Comparative elevations in proportion to stride.
Double dimensions of photographs - Scale: 1/24 in to 1 foot or 1:58.7
24ths of an inch graduation

where both joints drop one point correspondingly. Fig. 134 treats of the elevations of these joints as they are, with this natural differ-

ence in height. We have, therefore, the proportions between elevations of hock and knee action, as follows:

	Subject	*Hock Joint*	(proportions)	*Knee Joint*
1.	Elaine	12	(.86)	14
2.	Occident	11	(.73)	15
3.	Edgington	11.5	(.82)	14
4.	Clay	11	(.85)	13
	Average	11.4	(.81)	14

To get the hock action itself and compare it with the knee action we must reduce the former to the same base line or reduce the elevations of hock joint 20 per cent. Hence we have:

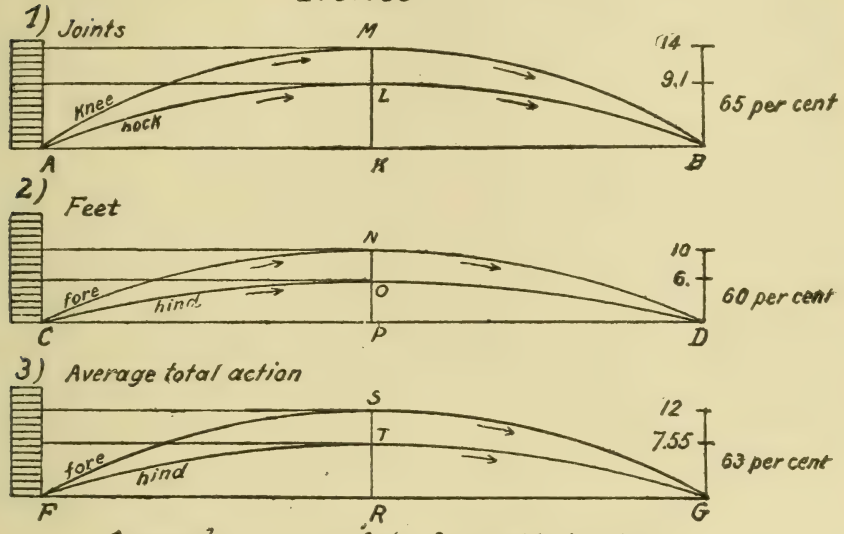
	Subject	*Hock Action*	(proportion)	*Knee Action*
1.	Elaine	9.6	(.685)	14
2.	Occident	8.8	(.585)	15
3.	Edgington	9.2	(.655)	14
4.	Clay	8.8	(.675)	13
	Average	9.1	(.65)	14

Therefore, while the apparent proportion of hock and knee action is about 81 per cent. the actual proportion of the magnitude of hock action to that of knee action results in but 65 per cent. Fig. 135 — 1) will illustrate this to the eye. Recalling the curves of action as discussed in a previous chapter under Figs. 19 to 26 we can readily understand these comparative elevations by studying the action of the subjects in motion. In watching the hock action one is apt to locate it in the point of the hock rather than in the joint proper, for while it indicates as much, it does not give the real elevation.

Elaine shows on the whole the most evenly divided action between both extremities. Occident is an example of excessive knee action and its influence on the lowering of hind action; while Clay with an indifferent knee action has a well developed hock action, causing trouble, as we have seen in Fig. 25, by probable interference. Abe Edgington is nearest the average found and presents here a good average trotter. Particular note should be made of the backward

extension in Elaine and Clay. This is a characteristic of good hock action, or should be so, and again shows how propulsion is effected by an equal backward and forward swing of the leg rather than by too much low and forward extension.

Fig. 135



General average of the four subjects given showing comparative magnitude of action reduced to a common basis, and an average for total fore and total hind action

Let us now compare the elevations of the feet. We find the following figures:

Subject.	*Hind*	(*proportion*)	*Fore*
1. Elaine	7	(.70)	10
2. Occident	5	(.45)	11
3. Edgington	6	(.60)	10
4. Clay	6	(.66)	9
Average	6	(.60)	10

The elevations are all specially given in Fig. 134 for each subject discussed and again in Fig. 135 — 2) as a general average of the proportion between the elevations of hind and fore feet. From that

we find that 60 per cent. constitutes the average elevation of the hind feet as compared with that of the fore. And finally, when the total action of both the joints and the feet is taken together as one whole, we find that the hind action is but 63 per cent. of fore action, as illustrated in Fig. 135 under 3.

Again, we have in Elaine the hightest proportion (.70), with Clay coming next. The latter is deficient in front action and the proportion is therefore high (.66). The greatest disproportion again appears in Occident, whose excessive knee action discloses again too low a hind action to bring his locomotion into proper proportion. While in Elaine and Clay the proportion between hock and knee action (.685 and .675) is nearly the same as that of hind and fore feet action (.70 and .66) there is a marked difference in Occident and Edgington, their proportion of hock and knee action (.585 and .655) being much higher than their proportion of hind and fore feet action (.45 and .60). This proves that the hock flexion of the first two is far greater than that of the last two, as can be readily seen in Figs. 23 and 25. That is to say, in both the former cases (Figs. 22 and 24) the backward extension was greater, which resulted in greater flexion of hock.

The point raised in connection with these investigations is that excessive front action, whether natural or effected artificially, has in its wake a lowered hind action; and again, that such lowered hind action is likely to result in greater forward extension of hind feet, because the greater curve of action of fore foot will produce a correspondingly longer curve of action of hind foot (Figs. 19-21); and if the backward extension is lacking and the hock flexion in consequence is absent the *forward extension* of the hind foot will be all the greater in order to equal the greater front action. That is to say, the action of the hind foot must consume the same period of time as the fore foot in going from one contact of ground to the next and must, moreover, strike the ground simultaneously with it. It is easy to see that the higher the curve of action the greater the time consumed, and hence, the curve of the hind foot being lower is apt to extend further forward to equal the action of fore foot in scope and time.

This quartette of horses, now again used as examples of gait or

action, constitute an excellent variety of equine locomotion, and the average from them should stand for a reliable standard to judge others by. The conviction that Muybridge gave us more than mere pictures has, I think, been sufficiently confirmed by the deductions made here. He gave us, in fact, something of inestimable value to the student of the horse, and the more we study these reproductions—very well done considering the times and the appliances—the more must we feel their importance and great worth.

The excessive knee action of Occident and the defective knee action of Clay, with the latter's probable interference as seen in Fig. 25, has ever given rise to the idea that the main purpose in curing hind interference is to get the fore feet out of the way of the hind. Somehow, it is thought that the hind must have the privilege of reaching forward to get a hold of the ground which is to be shoved back quickly, so to speak, to attain speed. Of *backward* hind extension as a cure for interference, little is said; but on this very question of proper adjustment of hind action depends the balancing of most trotters. A trotter *must* have good knee action to be speedy, but he *should* have good hock action to balance himself well and in a more natural way than is customary. Where heavy front shoes are used to develop action, very light shoes are generally applied to hind feet, the heel calk being the only design to check consequent forward extension of hind. The weight of the shoe is so intimately connected with its shape that the effect ought to be considered as a whole, though the effect of any difference in weight will appear in any case submitted. Too much stress is laid on weight anyway, whereas the shape of the shoe, and of the foot, is of far greater importance. That is why the great skill of our American shoers has accomplished such wonders. No more ponderous shoes of freakish shapes, but plain shoes with nice devices on them to direct action and motion, and shoes well and intelligently put on a well pared foot—these constitute the great achievements, simple in result, but difficult of attainment, which are the causes of the present improvement of both gait and speed of our trotter and pacer.

Let us now take the cases for illustration that have been shown to

contain the proof of the influence of the weight and of the shape of shoes. While it may even before this have appeared as if it was often necessary to use unequal weights on opposite feet, it should be borne in mind that such differences are rarely of a permanent nature. Structural faults—unequal hoofs or unequally developed muscles—may require such a permanent adjustment, and any faults of gait may be corrected by such a course; but it should also be remembered that the normal condition of equality on *both* fore and a similar equality on *both* hind should be the best way to balance the horse, if his anatomy is equally well developed at each extremity.

It should also be remembered that the greater the speed the smaller the changes necessary for a better balance; but the claim that a "rough" gait at slow speed will become "smooth" when the speed is increased is too often based on a deception of observation. By the greater exertion of increased speed, the faults become less visible or audible, but they will remain just the same. Training out deficiencies of gait by driving or working can never be a logical or intelligent method of perfecting the gait. It is merely a blind-man's-buff illusion of trying to get what we want without knowing where we are at. A temporary remedy is the only proper thing to apply after the fault has been definitely located, and this is always within the mental reach—or should be so—of a competent trainer.

Mere weight of the shoe, regardless of the shape of the shoe or of the angle of the foot, has the general effect of increasing the activity in both fore and hind feet. But as far as its effect on extension is concerned, there seems to be this distinction, namely:

In fore legs, mere weight is apt to decrease extension and increase elevation.

In hind legs, mere weight is apt to increase extension and decrease elevation.

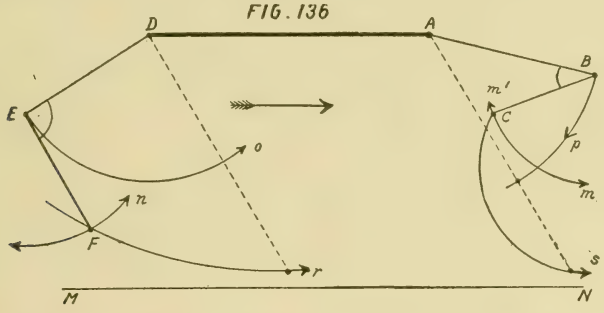
For the difference in elevation and extension so brought about, compare the Figs. 20 and 21. At both extremities weight gives to the feet a better direction and in consequence it steadies the motion of the horse.

To illustrate the point in question, Fig. 136 may add clearness to

the equine locomotion. I have always had in view the proposition of applying the kinetoscope to the horse in motion by having the camera move alongside of the animal with equal speed. The result would be a stationary picture as far as the horse is concerned, with all the motions given in detail on the same spot, while the ground would apparently move away from the horse at the rate of his speed. The eye could then more readily follow each movement of the legs and body without being compelled to follow a series of pictures such as those of Muybridge of thirty years ago. Such an exhibit would be highly instructive and strictly up to date.

Fig. 136 is intended to show the probable curves of motion of the legs, as seen in such a possible exhibit. It is not claimed to be an exact representation of such motion, except in so far as it shows the relative

FIG. 136



positions of fore and hind legs and their angles at that position. They present a pair of correlated legs moving together in either trot or pace.

D A is a stationary line, D being the vertex of axis of hind leg. and A that of fore leg. The angles at hock (E) and at knee (B) are supposed to be just opening with the forward reach of the legs. At this moment the legs unfold and extend forward. The hock joint having D for a vertex and the knee joint having A for a vertex, will approximately describe the curves o and p; and the hind feet F and the fore foot C, having hock and knee joints for vertices respectively, *would* describe curves of motion indicated by n and m, were it not for the above mentioned curves o and p, which in turn modify or change the curves n and m. The resultants we will assume to be the curves r (hind) and s (fore). The dotted lines are the legs when extended

and about to touch the ground M N. This is about what would happen when the motions could be brought before the reader by the kinetoscope.

It will be evident why weight of shoe is likely to increase the rapidity of the motion curves n (hind) and m (fore)—these being the upward curves of hind and front action—and also why the difference between the rapidity of motion curves F r (hind foot) and C s (fore foot) is due not only to the difference in angles of E and B, but also to their different elevations. While the curve C s is and must be described more quickly than the curve F r in order to have both feet reach the ground at the same moment, the chances for extension for the fore foot C are not as natural as are those of hind foot F; that is to say, the direction of the curve F r of the hind foot is more inclined toward extension than the direction of C s of fore foot. In other words, the unfolding of fore leg is not, under ordinary conditions, as favorable to forward extension as is the straightening out of hind leg with its more open angle and better natural direction for extension as compared with the fore.

These conclusions were drawn from numerous cases, some of which will now be given. Great care has been employed in generalizing from the actual results obtained, and although the interrelation of the four moving feet makes the study of balancing very intricate, the repetition of effects from similar causes and with different horses should warrant the conclusions so drawn.

Through the kind co-operation of Mr. K. O'Grady and his sons of San Mateo, Cal., I have been able to accomplish a great deal in these investigations, and one of the interesting cases there was a bay gelding by Sable Wilkes. He was a powerful individual, with only medium action in front, and could trot a mile easily in 2:25, and besides was a great roadster, with the ability of pulling a buggy without visible exertion. He had, however, one fault that made him go uneven, and to remedy this he was taken in hand. His off hind foot was short in forward extension, and was often placed inside of the off fore foot, a common manner of shifting with horses so afflicted. Such a way of going was certainly fatal to speed around the turns, besides

causing an awkward and uneven gait. Weight on the off hind was the plan adopted. When he came into my hands for shoeing he was shod as given in Fig. 137. Front feet were very steep (55°), and the hind feet were not equal in angle, besides being a good deal longer in toe than the front feet, thus causing a pointing back of fore and a pointing forward of hind. The average distance between fore and hind was only 2.94 feet, while the overstep of hind over fore was 4.85

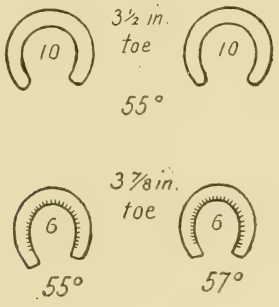
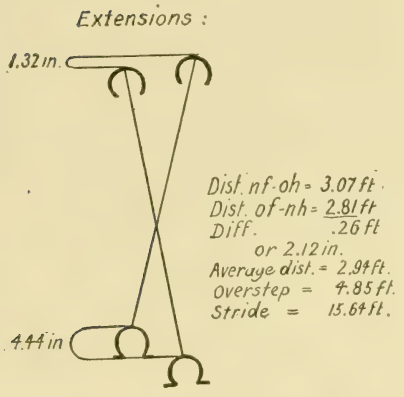


FIG. 137



feet for a stride of only 15.64 feet. There was also a visible influence of the retarded off hind on its correlated mate, the near fore.

To show how the off hind was deficient in extension, it should be mentioned that at times its extension was only 6 feet, while that of near hind was 9 feet, making together a stride of 15 feet. Or, again, it would be 6.90 feet and the near 9.05 feet, making a stride of 15.95 feet. Or, again, 6.90 feet, as against 8.70 feet of near, and so on. It

only once exceeded its proper proportion, or one-half of stride, and measured 7.85 feet.

The whole trial was irregular and unsatisfactory. The lateral extension and angles taken proved by Fig. 138 that the off hind was the disturbing element in the gait. Besides that, he hit his knees. Having little elevation, but great rapidity of motion, this animal gave the impression of being speedy. The main purpose, after stopping the knee hitting, was to try weight on off hind. At first the shoe was only 2 oz. heavier, which was gradually increased to 5 oz. In connection with this weight a lower angle and a longer toe was tried as a remedy. The changes were all made gradually so as to prevent any sudden jars by inequalities. No change in shoeing should be sudden or radical. At the end of four months he was shod as given in Fig. 139. It should be mentioned here that both the near fore and the near

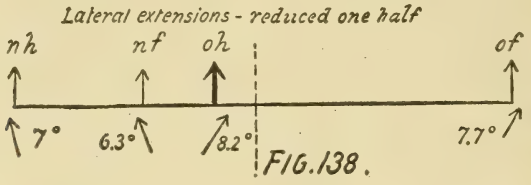


FIG. 138.

hind were somewhat dished in their frontal surface, and to counteract that a steeper angle of foot was maintained. Dished hoofs do not measure well on the hoof-gauge, and as a rule have a tendency to point forward, because this faulty frontal surface, normally straight, deceives the man who takes the angle of the foot; and the result is that such a foot is left at a lower angle and with a longer toe than its opposite mate. This alone causes an irregularity of gait, and therefore this fault of a dished frontal surface should always be taken into careful consideration. Hence, the near fore here appears with 1° more in angle of foot. Besides, this will facilitate the leverage of the dished toe. Both front shoes are beveled from toe around outer half to counteract breaking over on inside toe and to point *in* instead of *out*, which latter is usually responsible for the vicious inward curve of motion that causes knee hitting. The roll in shoe from toe to heel induces a little more action and elevation of fore, and the increased

weight has the same purpose. Behind we have the same length of toe and the heavy shoe on off hind, with a lesser angle to effect extension. The result shows some improvement. The separation of feet is 0.41 ft. or 4.92 in. more than in Fig. 137 (3.35—2.94), and the off hind is brought up closer, though not yet in proper position. This increased separation of fore and hind brought the gait more into harmony with

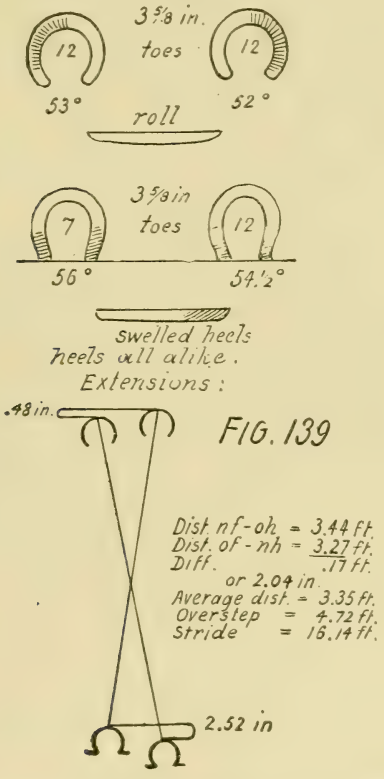


FIG. 139

the length of the horse; that is, there was a better articulation or swinging of legs at both ends.

The following year a similar plan of shoeing prevailed, and the gradual improvement is perhaps worth giving here, even in view of the fact that the one heavy hind shoe was not the only, though the principal, factor in effecting the desired even gait and balance. After two preliminary shoeings the one of Fig. 140 showed results as given below that illustration.

It will be noticed that the near fore is 1° more in angle than the off fore. It was assumed that such a greater angle facilitated the leverage of the dished toe. A dished toe naturally forms a lower angle with the heel than a toe with a straight frontal line. Fig. 141 will il-

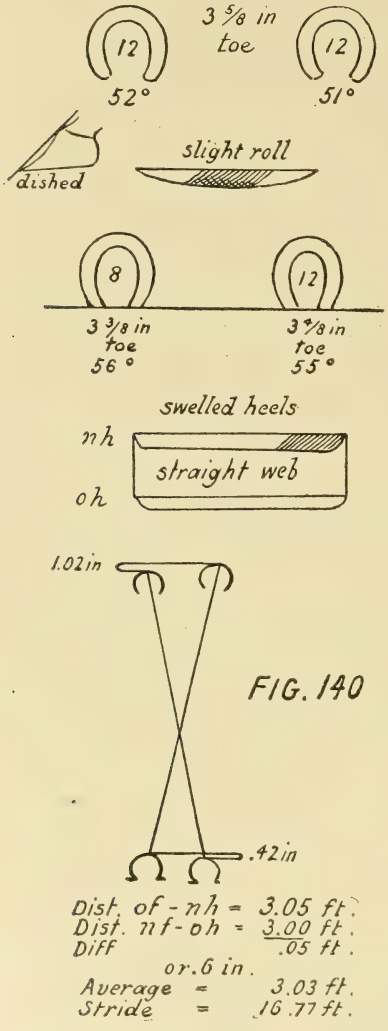
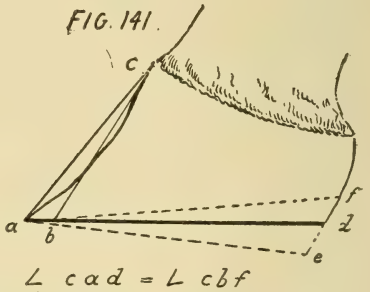


FIG. 140

FIG. 141.



∠ c a d = ∠ c b f
∠ c a e = ∠ c b d
∠ c b d is true angle of foot

lustrate this difference. Here the angle c-a-d is less than the angle c-b-d, because the point of toe at "a" is farther removed from the point of heel "d" than the point "b." The true angle of the foot is really c-b-d, with the dished toe rasped off to some extent, because the

point "a" of the dished toe and the point "c" of the coronet are not in a straight line common to all or nearly all the points in a normal frontal line. Hence we must strike an average frontal surface line by rasping off a part of the dished toe from "a" to "b," or nearly so, in order to make the angles of both front feet alike; or, again, we may leave the dished toe intact and increase the angle of that foot slightly to make it conform in effect to that of the other front foot. A great deal depends on finding the difference of extensions between the two feet; for, a dished toe is apt to cause greater forward extension, and, again, it may cause the leg to lag or point back on account of a difficult leverage at the toe. It is, therefore, important to find the effect by establishing the habitual extensions in front and then regulate the angles accordingly.

It will also be seen that off hind (Fig. 140) is ⅛ in. longer in toe, in order to cause greater extension according to the rules of David Roberge. Moreover, the lower heel or lesser angle of the same foot is a move in the same direction. The hind shoe being heavier, is naturally a little thicker in web, even though it was ordered wider rather than thicker in web. The supposition was that this leg lacked both length and momentum. In fact, in most trials the outside heel of off hind was too visible on ground. The impact and sliding of that heel hinted at some inability to suspend the foot from the ankle joint, or rather to keep it stretched forward in suspension until it would naturally strike the ground.

Subsequent shoeings on the same plan finally stopped the inclination to hop behind, which was due to this unequal extension of hind feet. There developed a gradual reversal of extension so that in the end, with the shoeing as given in Fig. 142, and with proper paring of feet to diminish the outward angles of feet and to counteract interference, the animal was driven three miles in 2:30, 2:27 and 2:27, the last one of which showed the result in extension given in that figure. The shoeing previous to this was about the same, the principal change being an increase of toe length of ⅛ inch all round and slightly swelled heels—but less so than on near—on the off hind instead of an even web. The angles of fore feet were also changed, so that near fore was

a little lower in heel than off fore. This lower heel, however, seemed to increase its extension somewhat and effect the better extension of the off hind also in a measure.

The feet with the longer toes (n f and o h) increased extension also in a measure. The final result can therefore be said to have been

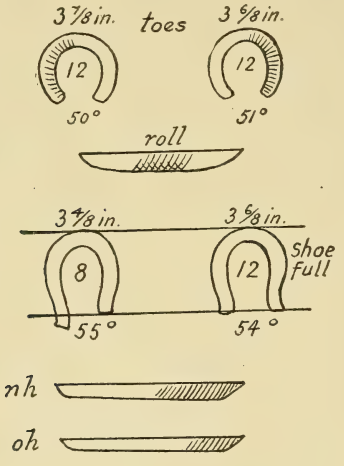
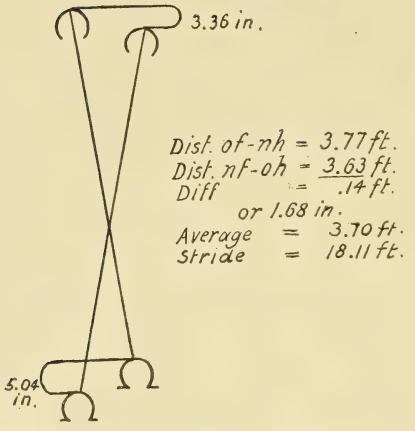


FIG. 142.

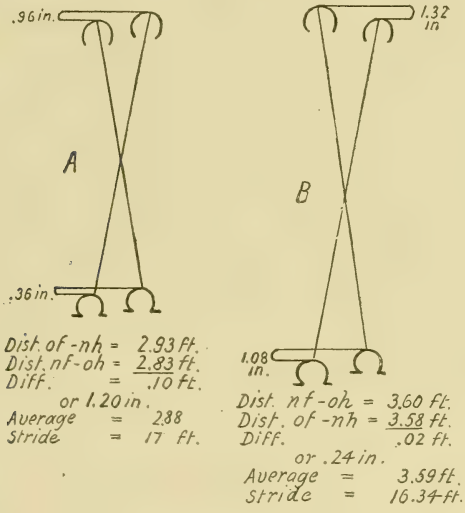


satisfactory. The horse took the turns well and trotted squarely. In this trial he was in a race with a horse of greater speed, and being fully extended, and with a long stride (18.11 ft.) for a rapid going trotter, it could be said that he was well balanced. Some modifications might have become necessary later on if he had stayed in train-

ing, as the effect of such an adjustment became more pronounced; but enough, at any rate, had been shown to warrant the plan of shoeing *gradually* evolved from the various trials.

Let us briefly consider the evolution of the gait due to various adjustments intended to regulate it. Without a plan based on previous facts, we could not logically bring about an improvement. We must, therefore, resort to a method by which we can establish comparisons in order to see clearly the effect of all changes made. Even if such a method as this is not followed out in every detail, the main principles

FIG. 143.



could be acquired by every trainer, so that he may be spared a good many disappointments and useless efforts when the whole matter of balance is left to guess work and its rough estimates.

In Fig. 143 we have a comparative representation of such an evolution of the extensions. The extensions given were the results of two trials made between those of Fig. 140 and Fig. 142. The shoes worn in Fig. 143-A and in Fig. 142 were alike, and those of Fig. 143-B were also the same with the exception of *off hind*, which had *no swelled heels*. The comparisons of these trials will illustrate what can be done merely by the paring of the hoof. Given, therefore, a set of shoes, it is in our power to vary the movements of a gait by a

different adjustment of the shoes. Aside from the difference of the off hind shoe noted above, there is only the paring of the hoofs as a cause for the various results.

In Fig. 143-A and B the angles in front were the same as in Fig. 142, that is, 50° and 51° respectively for the near and off fore foot, and behind they were both 55° in A and 55° and 54° in B, as in Fig. 142. This horse always did better with a lower angle on the off hind, on account of its lack of extension, and when that foot had a shoe without swelled heels, as in Fig. 143-B, it responded still better. Again, in Fig. 143-A both front feet were alike in length (3⅝ in.), but in B the near fore was 3⅝ in. and the off fore 3⅝ in. The lengths of the toes *behind* were in A: 3⅜ in. and 3⅛ in. respectively for the near and off hind; and in B: 3⅜ in. and 3⅝ in. for the same feet. The toes in Fig. 142 were all around ⅛ in. longer than in Fig. 143-B. This increased leverage at the toe no doubt had something to do with the greater variations from the average stride as noted below. The fact remains that the horse trotted remarkably square and true under the conditions of Fig. 143-B. The subsequent adjustment of Fig. 142 was rather an exaggeration of the previous conditions and therefore caused too marked a difference of the extensions.

The greater stride in the latter case (18.11 ft.) will naturally bring about a greater separation of the extremities, and will show up the effects in a more marked manner. By comparing the total variations of each leg from the average stride we shall again notice the influence of the different adjustments. We have the following:

Fig. 143-A, 17 Ft.—			
nf	of	nh	oh
7.30	5.15	7.35	6.87
Fig. 143-B, 16.34 Ft.—			
5.34	4.16	6.57	4.85
Fig. 142, 18.11 Ft.—			
11.25	12.27	13.23	9.59

Here we have the smallest variations in the trial which was trotted best and with the least apparent effort. It should be remembered that

this horse had an energetic and rather short gait, which seemed to be disturbed by the increased toe leverage of Fig. 142, as the variations above would indicate. The adjustment of Fig. 143-B suited him much better. These comparisons serve to bring out the observation that a horse can not always be extended much more than is natural for him, nor can his gait be shortened very much; but in either event the gait may be regulated so as to overcome an increased tendency toward a longer or shorter gait.

In all these trials nothing was done by means of poles to direct the off hind more to its outside line of motion, so that its direction would correspond with that of the near hind. The position of the off hind foot was no doubt an old habit which not even the increased extension of the off hind would rectify completely.

In Fig. 144 are given a series of lateral extension with the angles of the feet, which may give the reader an idea as to the extent to which the directions of the feet are amenable to treatment. The positions of the feet of the trial of Fig. 142 are not included, but they are very similar to those of 143-B, showing, however, lesser angles in front and a placing of off hind on the outside of the median line, as in Fig. 143-A on this comparative illustration of Fig. 144. Barring this confirmed fault, it goes to show that the shoer has more or less control over the directions of the feet.

A very small alteration in the way of shaping the feet and the shoes will result in a better direction, less interference, or none at all, and in an all round improved gait.

These five diagrams of Fig. 144 will indicate the possibilities of continued effort to correct the locomotion as regards the angles of the feet, and in consequence also the curves resulting therefrom. For instance, the fore feet toed out and knee hitting was the result. Reducing the angles to 4.7° and 5.3° reduces the inward curves, and there can be no interference, or at least very much less. Knee hitting, in this case, ceased altogether.

What we were discussing, however, was the influence of weight of shoes, and, though it has been shown that extension is increased and the action of hind legs equalized thereby, the influence of such

correction exerted on the fore legs should be borne in mind. In this case it was necessary to improve the extension of the off hind, and in accomplishing that we increased the extension of its correlated leg or the near fore. It seems impossible for a trotter to take the turns well

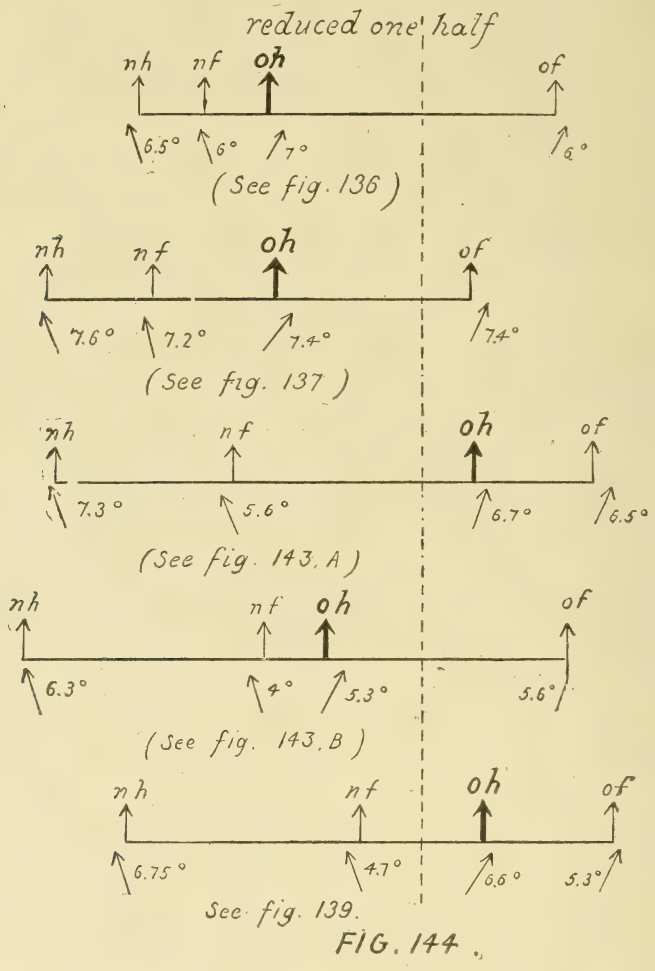


FIG. 144.

unless the off hind leg has a free swing forward and unless, likewise, the near fore takes the lead ahead of the off fore.

The case wound up with an excess of extensions in both near fore and off hind. It may, therefore, become necessary to modify such excess by the various means at our command. The principal point at

issue was to effect the equal extension of hind legs, on which balance and a square trot depended in this case. Now let us examine similar cases and verify the case just illustrated.

A Nutwood Wilkes gelding with near fore leg weak on account of a swelled tendon and with a bog spavin on near hind, presents another case of unequal extensions by reason of such faults or unsoundness. In his action he was bold and impressive with fore and showed a fairly good hind action. His weakness, as mentioned, became evident at his first trial, where he showed a greater extension with both off fore and off hind. In a trotter such extension on one side does not forebode any good, because the greater extension should more naturally result diagonally and not laterally. In this horse the excess of extension was as follows:

Off fore over near fore = 0.28 ft., or 3.36 in.

Off hind over near hind = 0.51 ft., or 6.12 in.

He wore plain shoes, 8 oz. in front and 6 oz. behind, the fore having an approximate angle of 49° and the hind 53°. His natural attitude in front was straight, but behind he stood under slightly. The average distance between the correlated feet, or between front and hind in general, was in this trial only 3.03 ft., with an overstep of 5.22 ft. For a long-bodied horse these were out of proportion to his stride of 16.5 ft.

Our next trial was after a shoeing intended to show the effect of different lengths of toes. By having near fore toe longer than off fore, the extension of near fore was increased (to avoid a shock to the injured leg on account of such a longer foot); and by the relation between it and the off hind, the latter extension—even then excessive—became greater still, and the difference between hind extensions was quite abnormal, being 10.92 in. greater on off hind. While the fore extended as follows:

Near fore.	Off fore.	Total.
8.31	8.27	16.58

The hind showed:

Near hind.	Off hind.	Total.
7.38	9.20	16.58

Dividing the actual difference by 2, we have, as before, a very small difference in fore extension, but a very large difference in hind, as above noted. The average distance between the extremities was in this case 3.12 feet.

Then followed a shoeing—at the usual interval of three weeks—which was also not quite correct. It appears in Fig. 145. The equal lengths of toe in fore put the extension of off fore back to where it was; and the square toe on the off hind facilitated action and counteracted the greater weight on near hind and its own steeper angle.

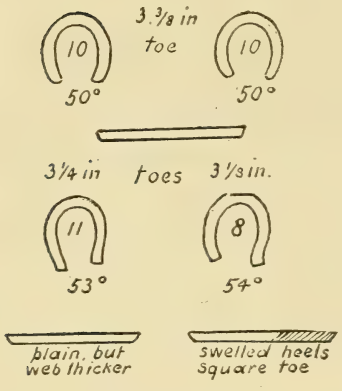


FIG. 145

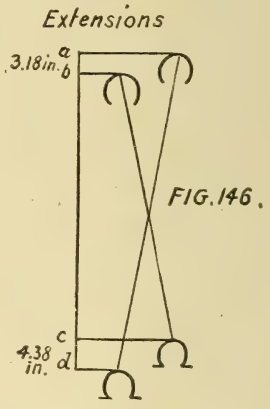


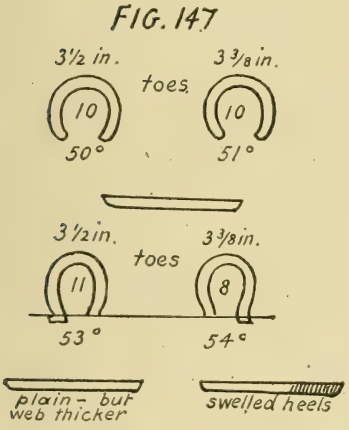
FIG. 146.

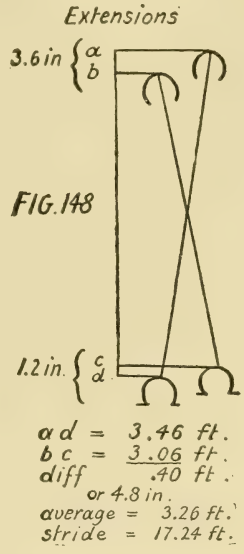
a d = 3.25 ft.
b c = 2.62 ft.
Diff .63 ft.
or 7.56 in.
Average = 2.94 ft.
Stride = 16.18 ft.

We have therefore the same faulty extension on off side, with which a trotter can never accomplish a square gait. The distance between fore and hind (2.94 ft.) is also smaller than it should be for the stride of 16.18 feet.

The following shoeing was done according to the indications of the previous trials, and appears in Fig. 147. The result of it was a somewhat better gait and a greater extension of near hind, together with a checking of off hind extension. The off fore again extends more than near fore by 3.6 inches, slightly more than in Fig. 146. While its distance from near hind increased by 0.21 ft. (3.46 — 3.25)

over that in Fig. 146, the distance on the other two diagonal feet increased by 0.44 ft. (3.06 — 2.62), showing in all the regulating effect of weight on near hind, as well as a somewhat greater reaching out of both fore in this stride of 17.24 ft. It appears again as if a greater stride would have with it a greater separation of front and hind extremities. The conclusion is in a general way correct, and is sustained by other investigations. The comparisons here of the two strides given—16.18 ft. and 17.24 ft.—and their respective average distances between fore and hind—2.94 ft. and 3.26 ft.—will present with suffi-





cient clearness the general effect of a change of shoeing; and it will also serve as an illustration of the danger that lies in the lengthening out of the animal's body by the strain that is put on its back and its tendons. It is, therefore, well to bear in mind this distance and its proportion to the length of the animal as it appears when at rest; that is to say, such a distance between the extremities when the subject is at rest will, *with some horses,* decrease somewhat under great speed because of the backward propelling power of the fore legs and the anxiety of the hind legs to gain ground and, so to speak, take a hold of it to effect propulsion. The same observation can often be made in

draft horses when they start a heavy load. It all depends on conditions and is largely due to conformation. As a rule, however, an increase of speed will separate the extremities a little more than usual, and if no excess results it seems quite natural for the horse to do so.

Such greater separation with increased speed is observed when forging ceases at a faster gait; but again the decreased distance or faulty approach of extremities shows itself in speedy-cutting. I believe that the proper distance between hind and fore is worthy of study and consideration, for it is really an important indicator of a good gait and enters largely into the question of balance, with a view to continued soundness.

The telling effect of weight is, of course, more readily accomplished by greater speed. What six additional ounces may cause at a four-minute gait, three ounces may do at a gait of two minutes and twenty seconds.

Elsewhere I have explained the auxiliary importance of finding the variations of the actual strides of the four feet from the general average stride in order to see which legs are more active or more regular. The smaller in scope these variations are, that is, the less they exceed or fall short of the average stride, the greater must be the regularity of that gait. While the case last considered showed the effect of weight and would in time have shown a more correct and even extension, these variations were quite excessive. Here it is where variations indicate a fault or unsoundness that incapacitate the animal from continuing a racing career. The subject at a stride of 17.24 ft. showed the following variations from that average:

Near fore.	Off fore.	Near hind.	Off hind.
+ 5.45 — 5.45	+ 5.93 — 5.84	+ 8.96 — 7.16	+ 5.61 — 5.91
	Total Scope.		
10.90	11.77	16.12	11.52

proving according to the rule in Chapter IV. that off fore is the stronger leg because of its greater variations, and off hind is the stronger leg because of its lesser variations. In fact, the near hind

shows very excessive variations (16.12), which cannot possibly be conducive to speed or to a really square gait. This is mentioned merely to bring up the matter of variations as an auxiliary indication of the disturbing causes of an irregular gait.

Other experiments have repeatedly shown this influence of unequal weight in hind shoes. It is not claimed that these shoeings were absolutely the only correct ones to put the subject into the proper gait, although the effort was always directed toward that aim. Take, for instance, a third case where weight was thus applied. The subject was well bred, but knuckled over behind, causing irregular extensions in both extremities and too great a scope of variations. The horse was said to have trotted a full mile in 2:17 and was by Directum. He generally went pretty free and bold with fore, but behind skipped a good deal, although his hind action was above the average. He also had the bad fault of greater forward extension of hind over fore; that is to say, though his average step was 15.80 ft., the fore together averaged 15.77 ft., while the hind together averaged 15.84 ft. This does not by any means indicate that the hind stride was continuously longer than that of the fore, but that for those 20 strides the tendency of hind was to be more active than the fore, and in this trial the hind legs seemed to be running or bounding along. If more of the ground had been measured and additional data had been taken, it would have been found that such a longer stride (0.84 inch) did not prevail in the total distance, always provided the horse had trotted squarely. There was, however, this tendency of excessive hind activity, and the individual extensions of feet were as follows:

———Fore———		———Hind———	
Near.	Off.	Near.	Off.
8.12	7.65	7.29	8.55

Dividing the difference between fore by 2, we have 0.235 ft., or 2.82 in. for the position of near fore ahead of off fore; and likewise with hind we have the off hind 0.63 ft., or 7.56 in., ahead of near hind. The horse wore 12 oz. in front and 8 oz. behind. The toes were 3¼ in. long all round, and the fore had an angle of 49°, while the hind

were 54°. Great irregularity of gait was expressed by the total variations from average stride:

———Fore———		———Hind———	
Near.	Off.	Near.	Off.
10.20	15.30	15.55	10.65

The distance between extremities being rather long—3.88 ft.—a further separation by means of toeweights seemed ill-advised. Hence the idea of unequal weight suggested itself.

During the previous season the horse had received some attention and some success had been achieved by merely shaping the length of hoof and angle differently on hind feet. A higher angle and a shorter toe having generally less extension than a lower angle and a longer toe, the desired result was effected; but habits of extensions, such as skipping behind, are hard to eradicate, and after a while the horse relapsed into his old way of going. It was, therefore, necessary to emphasize or exaggerate the difference by weight, toe and angle all at the same time. I did not from the start consider this case amenable to treatment, but to prove the effect of weight with a resultant improved gait this plan was followed out. Fig. 149 will illustrate this shoeing, and the consequent extensions. There is apparently a conflicting testimony in the treatment of the fore feet as compared with the fore of Fig. 147, the extension of the latter being greater with the foot of longer toe and greater angle, in other words, with the longer foot or the off fore; while in this case (Fig. 149) the apparently shorter foot takes the lead. The latter effect is generally found to prevail, and this horse being sound in front, while the previous subject was unsound in the near fore through a swelled tendon, seems to prove the rule by the greater extension of the off fore.

The idea of having the hind toes longer than the front toes was erroneous, and especially with a horse that inclined to knuckle over. This horse always had had longer hind toes and hence the suggestion at the time. The main remedy for knuckling over seems to be an easy roll-over at the toe; that is, a roll in shoe from heel to toe, but with a slightly beveled heel to check the rapidity of the break-over

towards the toe. If, however, the heel is arrested suddenly or sinks too far into the ground, the ankle will go over as before. It seems as if the suspending ligaments have lost their power to keep the ankle joint in position long enough to allow the backward extension to be finished before the foot is again lifted for another stride.

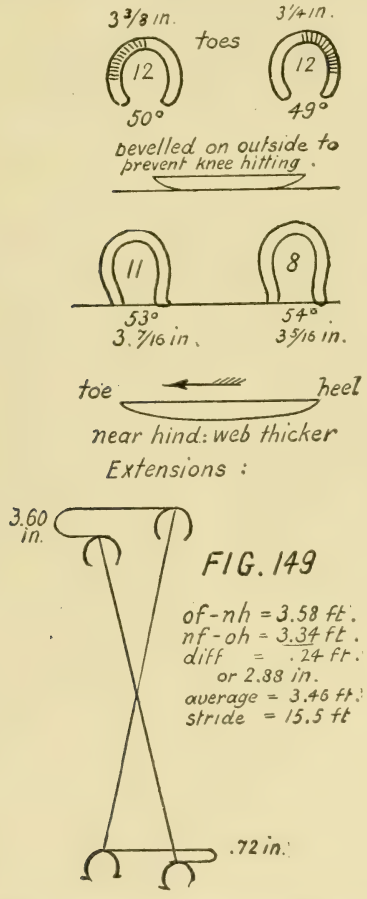


FIG. 149

It should be noted that the distance between the extremities is considerably less in this trial (3.46 ft.), as compared with that of previous trial (3.88 ft.), when the stride averaged 15.8 ft., or only 0.3 ft. more than the present stride of 15.5 ft. This difference is about 5 in. (0.42 ft.), and shows the greater approach of the extremities by the influence of greater weight and longer toes behind. Looking at the varia-

tions from the average stride we again notice a change for the better, viz.:

——Fore——		——Hind——	
Near.	Off.	Near.	Off.
9.29	9.57	9.83	11.24

This shows plainly that the two legs most deficient in extension—the off fore and the near hind—have now become more regular in their variations as against the previous trial, when they showed 15.30 and 15.55 in total of variations. But the variations are still too wide in scope to constitute a regular gait.

Various other applications of weight to the hind feet have had the same result when the object was to equalize the extension of both hind. It is well to bear in mind that the effect of weight as far as extension is concerned depends also largely on the shape of the shoe. In the last case, for instance, we might have directed the hind feet differently and prevented their extensions from being greater than those of fore. Instead of rocking motion shoes with a thin heel, there should have been swelled heels on both hind shoes and a square toe on near hind to accelerate action, which in this case would, by the extra weight, have caused greater extension; but such a course would have been detrimental to the weak ankles which needed the rocking motion of shoe to prevent further injury and to lessen the knuckling over of these hind ankles. This horse was, therefore, not free from the aggravations of unsoundness; but such is the lot of the man who undertakes to convert a badly gaited horse into a well gaited one: he is apt to be given the hardest cases. Many cases will come and go like the shadows of passing clouds, and the expectations of the man in trouble remind one of the signs in small tailor shops: "Clothes mended while you wait." Many may differ with me in the application of the remedy, but I believe that the experiments embodied in this extended investigation of the trotting gait will be sufficiently suggestive of remedies on similar lines. As long as the work is done with this method of analysis as a basis and an accuracy of adjustment is maintained, there must follow an improvement of the disordered gait such as the animal in ques-

tion is capable of. The experiments are not given to be followed implicitly, but are rather to be accepted as suggestions in reasoning out such an improvement of the gait by means of a method which is here offered as a rational solution of the problem of balance.

Having considered, in a general way, the effect of weight of shoes on hind feet, we shall now proceed to investigate the effect of squared toes on any one or on all feet, incidentally examining weight on front feet, and then passing on to the effect of longer heels on hind shoes.

A.—Squared Toes of Shoes.

We will first, however, look at the effect of equal weight on *both* hind feet when using a shoe that will facilitate the break-over at the toe, that is, the shoe with the squared toe. A filly by Sidney Dillon presents just such a case where weight of hind shoes was directed by the shape of the shoe. This filly had good front action, which was straightly directed, and because the hock action was also good, she was shod in the customary way: 9 oz. in front and 6 oz. behind. The usual prejudice against interference with the hock action prevailed, and the same old principle of getting the fore feet out of the way of the hind feet was believed to be the only proper manner of regulating her gait.

Most of my trials took place on a piece of an old track well kept up, and of a fine loamy soil that afforded excellent footing when it was cared for; but there was a slight incline on the stretch, and while most trials were made downhill, many a one was taken both ways. This filly could always trot more steadily and strongly when going uphill. She would lose the shifting or skipping behind and pick up her feet in a more exact manner. This fact first suggested the trial of heavier hind shoes both in this case and in others that afforded a similar observation. This going downhill and uphill is similar to the two ways of going of Edgington in sulky and under saddle, as given in Figs. 28 and 29, where the weight on his back acted like the depression of hind quarters as caused by the uphill movement of the filly in this case.

This case is a very fine example of the influence of weight on hind feet and of its direction by the shape of the shoe. It is a case where a well developed hind *action* under ordinary work changed into an excessive hind *extension* which was not in harmony with front action. From the usual 9 oz. in front and 6 oz. behind, indications suggested the unusual 6 oz. in front and 9 oz. behind. Through it all there was a queer tendency to extend both members of the near side ahead of those on the off side, as if the subject would prefer to pace; but this she never offered to do. The experiments were made in two seasons, the

FIG. 150.

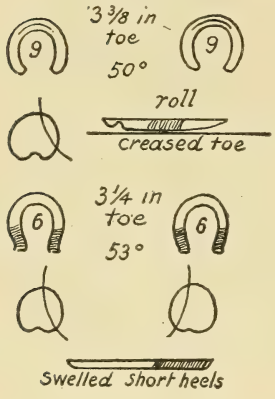
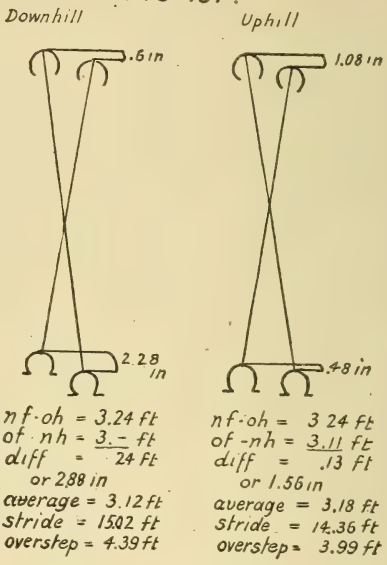


FIG 151.



first one ending as above stated regarding the shoes and the second beginning again on the old plan, but quickly changing to the final decision, which not only lengthened her stride, but increased her speed very considerably.

After a preliminary trial made to get an idea for the next shoeing, she was shod as given in Fig. 150. The near fore had a tendency to toe in so that, while at previous trial the off fore showed 5.5° *outward* toeing, the near fore showed —3.2° or that much *inward* toeing. By paring the foot as indicated under the shoe, the near fore at this trial showed 0°, or a straight direction.

The hind feet in previous trial showed a lack of distance between them, and by paring inside of both we gained an increase from 4.3 in. of previous trial to 7 in. in this trial. Her gait was therefore more open, as intended.

There being also an uphill trial, I give the extensions of both in Fig. 151. Although the stride of the downhill was naturally longer (15.02 ft.) than that of the uphill trial (14.36 ft.) by 8 in., there was a slight increase in the separation of the extremities (about ¾ in.) and the overstep of hind over fore on either side was a good deal less, namely, 0.4 ft. or 4.8 inches, though this difference is not excessive, considering the shorter stride. It stands to reason that there was in the uphill trial a good deal more exertion at propulsion, as the variations from each average stride will prove, namely:

DOWNHILL.

Total Var.		Total Var.	
——Fore——		——Hind——	
Near.	Off.	Near.	Off.
+ 1.73 — 1.78	+ 1.72 — 1.27	+ 1.49 — 1.84	+ 2.04 — 2.39
3.51	2.99	3.33	4.43

UPHILL.

+ 2.40 — 2.58	+ 2.95 — 2.80	+ 3.19 — 3.09	+ 3.29 — 2.99
4.98	5.75	6.28	6.28

The hind feet seem to have less forward extension, as the difference in the oversteps will show. The reason that the separation of extremeties is not greater (3.18 ft. — 3.12 ft. = 0.06 ft., or ¾ in.) lies in the fact that the fore feet also tend to have more backward extension going uphill. The off fore that was behind the near fore going downhill points back still more, and the near hind that pointed forward going downhill now ceases to do so going uphill. With this greater action of hind we lose therefore the too free activity of the near hind, and the result is that the extension of both hind becomes more equal than it was going downhill.

This incline of the track was surveyed and showed on the stretch used for the experiments the following grade:

14 inches in 400 feet.

This is an incline not too steep to cause any material commotion in the animal's movements, and represents about the usual downhill path of the homestretch on many tracks. Since a horse is supposed to make his greatest efforts at that part of the mile, he should show then the best possible gait and balance, and as it is a severe test for the balance of the horse to be compelled to control the additional momentum of a downhill path, it always seemed to me as being an appropriate place to find out the very faults of gait which cause distress. Still more appropriate were the double trials; that is, one shoeing tested in both downhill and uphill directions, which will be discussed in Chapter IX.; but many other trials were made on level tracks.

Wishing to give this matter another test before reversing the weights of the shoes, another trial was made with the same shoes reset and angles of hind feet lowered 1°. With about the same stride downhill (15.08 ft.) and a similar one uphill (14.23 ft.), there is still a larger difference in the averages of extensions behind in the downhill trial, namely:

———Fore———		———Hind———	
Near.	Off.	Near.	Off.
+.09	0	+.42	0

Now, having the subject trot uphill, we have:

———Fore———		———Hind———	
Near.	Off.	Near.	Off.
+.03	0	+.10	0

which all means that in the downhill trial the near fore preceded the off fore 1.08 in., and the near hind preceded the off hind 5.04 in.; and that in the uphill trial these differences dwindle down to negligible distances. Again comparing the other distances we have:

	Stride.	Dist. correl. feet.	Oversteps.
Downhill	15.08	3.30	4.24
Uphill	14.23	3.34	3.77

which are all in about the same proportion as those of previous trials, with perhaps a shade less separation of extremities than formerly.

My notes say that she trotted very much better uphill than downhill. It will be observed that the distance between the extremities in the downhill trial with the longer stride is less than that of the uphill trial with the shorter stride, showing thereby the excessive activity, or rather the excessive extension of the hind legs downhill.

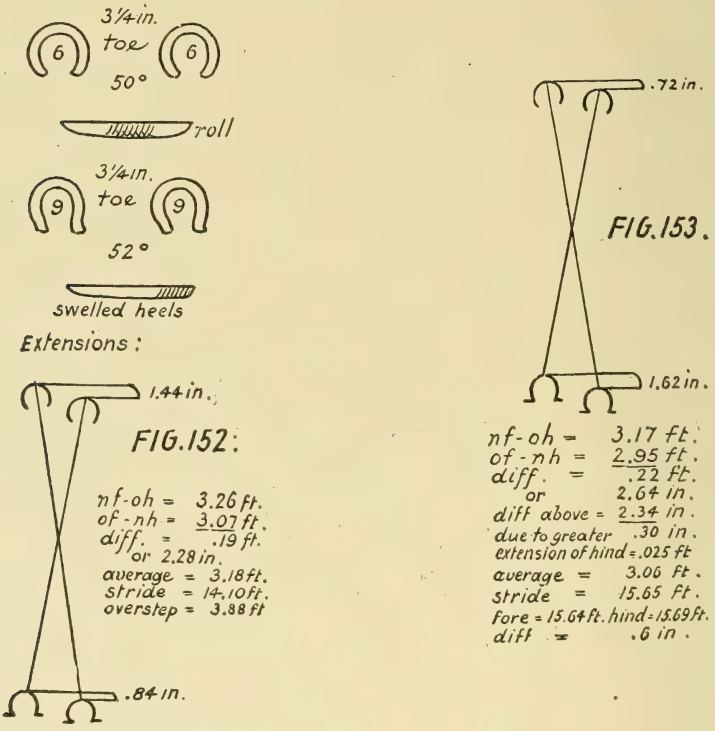
These trials, therefore, determined me to put 6 oz. shoes on fore and 9 oz. shoes on hind feet. The tradition is that such a change is likely to bring about a pacing gait. In fact, with the extensions on the same side (i.e., near side), I was inclined to fear that; but shod as in Fig. 152, she trotted fairly well, except that her gait was a little irregular, and the hind shoes slid a good deal at the heels. She also forged a little now and then. The result showed some improvement, but there was still that pacing extension on near side. The stride was not as extended, and appeared to be a little short-gaited or tied up.

The season was near its close, and a few trials with unequal weight in hind shoes did not improve matters very much. These trials proved again that the relation between fore and hind enters largely into the effect which any unequal weight may have on one particular foot. Besides, there are length and angle of toe, and the shape of shoe to be considered. Experience has shown me that any difference of length of toe is not conducive to an even gait except where there is a difference in the size or shape of the hoofs, or where in conjunction with a higher heel the whole leg is lengthened by a fraction of an inch in order to counteract any difference in length between two opposite fore or hind legs. So much depends on the evidence of the tracks, which reveal the weak points of the four feet, that enough stress cannot be laid on its study. No horse is perfect, and all four legs do not always move and act alike. The difference may be a temporary habit, but it may also be a permanent structural inability, which can be found only by a persistant analysis of the gait and overcome by shoeing to meet the demands of a square gait.

Even in these last trials of that season it became apparent that the weight of shoe and the angle of the foot worked well together as a combination and that when the conditions of length of toe and shape

of shoe were equal as regards either the two fore or the two hind feet, the former could be effectively used to regulate the gait of the filly.

The following season this filly was again shod on the old plan, namely, 9 oz. in front and 6 oz. behind, with an angle of 48° on fore and of 52° on hind, the front toes being 3⅝ in. and the hind ones 3½ in. The shapes of the shoes were the same as before. While the fore showed a fairly good hold of ground, the hind plain shoes slipped now at heels, now at toes. Fig. 153 gives the extensions of that shoeing and



trial. We still have the greater activity of the hind legs; in fact, it is too plainly seen in the two averages of the fore (15.64) and of the hind (15.69). While I still contend that the average stride for all four legs must be the same, the small difference between fore and hind average in this as well as in a former case serves to indicate a lack of harmony between the fore and hind action. In a square gait such differences do not appear and can not exist. The average distance between extremities is again closer than it had been and by observa-

tion it was seen that action in front was higher than it used to be. At a distance it gave the impression as if she was single-footing just a little now and then. From the variations of the strides it was seen that they were all nearly the same, with the exception of the near fore, which exceeded the other three, showing the tendency of that leg to point forward. This may have been due to the near hind reaching forward habitually, hence the greater extension of near fore to avoid the interference. It was evident that the hind extension had to be checked in order to equalize it with that of fore. As is well known, there are two remedies for that: *square toes* and *heel calks*. I chose them both for the next shoeing, and it was plainly demonstrated that the mare's good hind action could thereby be restored and converted from too much low extension into higher elevation. The front shoes were creased at the toe to afford a firmer hold, since the previous trial showed some slipping of the toes of the fore feet. The shoeing is given in Fig. 154. We notice an easier and longer stride and the expected check to hind extension. The average distance between extremities has increased to 3.32 ft., and the extension of off hind over near hind is quite marked. Again the observation was made that the turns were taken much better and more steadily and without loss of time or speed.

In the beginning of this chapter under Figs. 90 and 92, the advantage of just such a change of extension was explained, and this is another example of the importance of not only ascertaining what the extensions are, but also of trying to change them in order to have the animal take the turns with greater ease and without loss of speed.

I increased the angle of off fore because the toe on that foot was somewhat dished and flattened out; and in order to overcome such a toe leverage as compared with that of the opposite mate, the heel was raised. Observations to that effect were made in a previous case and will appear again subsequently. The off hind had likewise a somewhat lower heel than near hind, which may in part account for its greater extension. It may as well be mentioned that where such differences of angles or toes are made there may appear indifferent results; but much depends upon the accurate execution of the work,

and, if there is not the expected result, a second trial under similar but with more emphasized conditions should be made. Too much changing from one extreme to the other, and trials too soon after shoeing, all lead to confusion of results.

Aided by the eye, the last trial of this filly showed more room for improvement still. For the next shoeing I chose the one given in Fig. 155. There will be seen the change to heavier hind shoes again, a

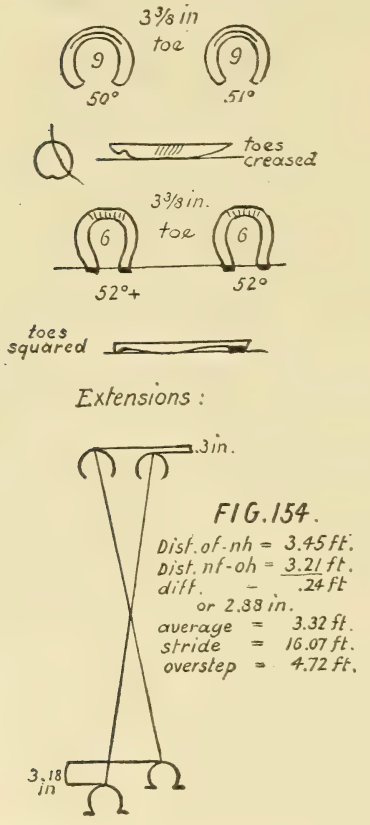


FIG. 154.

Dist. of-nh = 3.45 ft.
Dist. nf-oh = 3.21 ft.
diff. – .24 ft
or 2.88 in.
average = 3.32 ft.
stride = 16.07 ft.
overstep = 4.72 ft.

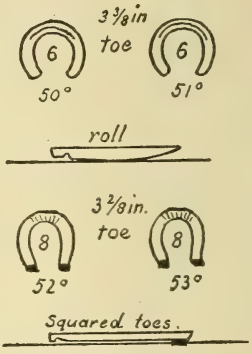


FIG. 155.

shorter toe for the hind than for the fore, and an increased angle for off hind to facilitate the turns in backward extension and to check any excess of forward extension, such as the previous trial indicated. The creased toe of front shoe and the scooped or concave toe of hind shoe, with a square toe at its point, were again employed. These creases prevent slipping in a measure, and the concave toes act like "grabs"

and keep hold of ground, while the heel calks of the hind shoe and its square toe enable the foot to break over quickly, thereby excluding a long contact with ground and inducing a higher action.

Unfortunately, no trial was made on account of a misunderstanding and the filly's subsequent removal; but there was a great improvement in her gait and speed. Whether subsequent developments showed this to be the right balance I do not know. She was going well then, and very soon after showed an easy mile in 2.27. Her fastest mile before that was about 2.45.

Her case again proves that weight on hind feet increases their extension and also that such extension can be converted into a higher action by the properly shaped toe, as in this instance the squared toe heel calk shoe proved to be.

It should be remembered, however, that the filly had naturally good hock action similar to that of Lou Dillon, and that the neglect of same caused it to become lower and more extended, which spoiled her gait. Only by bringing it back to its former elevation by the proper shoe, were her gait and speed improved. My former contention, therefore, that the hind action should be looked after as well as the front action and that heavy shoes in front do not by themselves solve the problem of balance, seems to be borne out in this case as well as in other cases.

As regards weight in front shoes, I have also some evidence to offer to the reader. Let me again urge upon him the necessity of having a clear analysis of the gait of the animal to be shod, so that the intelligent horseshoer may at least not be quite in the dark as to what remedy to apply. It should be the trainer's business to ascertain the peculiarities of gait in detail and also to know the various results from various shoeings. Great nicety of adjustment of shoe and hoof is the first requisite of balancing a horse, and this the shoer can only accomplish when properly instructed as to the manner of locomotion.

Action in front is not always amenable to remedies intended for greater extension. We have seen that toe-weights have that influence on extension to a certain degree; but again much depends on whether the action is rapid or naturally more sweeping. Heavy shoes

in front have a better effect on the rapidly gaited trotters and toe-weights bring apparently the best results on those with a longer reach. Equally heavy shoes in front seem to increase elevation rather than extension of action; they help to balance the horse by giving the action in front a certain regularity and steadiness.

The direct effect of weight in the shoe—provided the same is equally distributed in the web—occurs with the flexion rather than with the unfolding of the leg; in fact, it increases the flexion of the leg if so directed by the shape of the shoe.

To illustrate the relative flexion of fore and hind legs again, let me call attention to Fig. 156. It represents a simple piece of machinery such as the eye presumes to see on one side of a trotter. Let A B be the body and A C H the hind and B D F the front articulation in

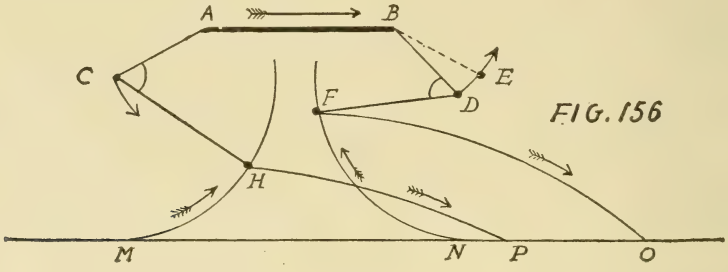


FIG. 156

general. The direct effect of weight on H will be upward (M H) and *forward* while the angle at C closes; while the same effect on F will be also upward (N F) but *backward* while the angle at D closes.

The flexions both at C and D are here presumed to be at their greatest point, and H as well as F at their highest elevation. The remaining parts of the paths H P and F O have therefore a downward tendency, with this difference: C having reached its greatest elevation, its angle unfolds or opens more readily, and the momentum of the weight in shoe is therefore more readily transmitted in a more *forward* direction, while D, though at its greatest point of flexion, is raised still higher (E), when its angle opens, and in the path of F the momentum of shoe is therefore transmitted in a more *downward* direction. In other words, at the unfolding of the hind leg the momentum of weight is directed in a more horizontal line, while at the

unfolding of the fore leg the momentum of weight is directed in a more vertical line.

The angle at C is open toward the direction of motion, while the angle at D opens in an opposite manner and away from it. Therefore it is evident that forward extension is much more natural for the hind leg than it is for the fore leg. While weight on the hind foot may lower the elevation of action, it easily increases extension; but in order to increase extension in the fore legs we must not have too great a flexion of knee or closing of angle B D F, but rather a sufficient elevation of the knee D, together with a gradual unfolding or opening of the angle at D, so that extension may be more easily accomplished.

Reference is again made to Fig. 20, which gave the resultant elevation of the foot due to high action and a sudden unfolding of knee flexion in the curve A C, and the resultant greater extension due to a lower action and a more gradual unfolding of knee flexion in the curve A B.

The direct effect of toe-weight is in throwing forward the foot at the last part of the unfolding of fore legs, thereby increasing its extension. Mere weight of the front shoe induces greater flexion and somewhat greater elevation of knee. Much depends on the trotter's natural action in front, whether it be rapid or sweeping; and, again, much depends on the action of the hind legs and their direct influence on the fore. When a horse is naturally low gaited in front and has the additional vicious attitude of hind feet pointing forward, the problem of interference and of consequent balance is indeed a very hard one to solve.

While we cannot always separate the extremities in order to avoid interference and with safety to the animal, the work should not, if possible, confine itself to an effort for mere extension in front, but also for more backward action behind. And, furthermore, an increased elevation of hind action will also have its telling effect on the low action in front. This inability of "getting away" in front is one of the hardest problems of training and shoeing. Toe-weights will be effective to a degree, but the fault will be more or less of a bar to great speed. Very often this fault is due to an unequal extension of feet, and

this may be corrected if we can afford, by time and patience and slower speed, to carry out this correction. When investigating the gait of "Lou Dillon" we found a peculiar crossing over of fore legs. In a lesser degree this has been observed in other trotters; and although such a way of going appears freakish, there seems to be good reason for not disparaging that kind of locomotion. Aside from the absence of interference with the hind feet, no matter how far the latter reach forward, the fore feet seem to display a greater power for propulsion by their contact with the ground on opposite sides, as shown in Fig. 157. The feet that move together are on either side of that speedy mare and the shaded portions of the feet indicate the part of the foot that gives the impetus. Instead of its being the point of the front toe,

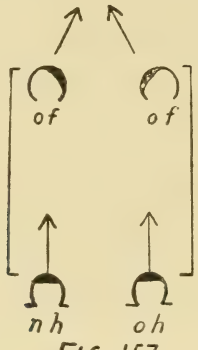


FIG. 157

where the leverage is often fatiguing, the outside toe effects the propulsion and does it more readily because of the smaller leverage. Behind the propulsion is effected by the full toe. Again, the slight sway of the body from side to side gives additional momentum to the motion of the horse. It is really a combination of the diagonal propulsion of the trot with the lateral propulsion of the pace. The picture of Cresceus 2:02¼ and his peculiar attitude always suggested to my mind a similar mode of locomotion.

A picture of Sweet Marie 2:02 at speed is given in Fig. 157a, and even here it becomes apparent that such crossing over of the fore feet is very likely a feature of her gait. The photograph at least seems to disclose such a fact. I have always regretted having been unable to investigate her gait, but distance and business forbade my doing so.

FIG. 157A.

But not all trotters have recourse to such an expedient to remove their forelegs out of the path of an active pair of hind legs, much to the sorrow of the trainer; and hence there will always be more or less trouble in the balancing of those horses that have indifferent action in front.

Roberge's general rules for extending the reach of a foot by lowering its angle and checking it by increasing the angle of the foot are primarily true of the bare foot, or of the foot shod with a plain shoe, but under certain conditions these rules require some modifications. Much as I am against the use of shoes of unequal weight or of unequal shape, or of any inequality of length of toe and angle between the fore or between the hind, there are many cases where a regular gait and the best speed are effected in making *just such differences.* Combinations of various weights and shapes of shoes, as well as of various angles and length of toe, are obviously great in number; but the main object of all such combinations must remain that the *distances of the two pairs of correlated feet* should be at *all times the same.* Only when such distances are the same can we expect an even, faultless gait. We cannot always equalize the extensions, and if these differences are slight no danger springs from them. We have already noticed how a horse may be benefited by an increased extension of the near fore and off hind when taking the turns; in fact, the difficulty of getting around the turn is mostly due to the increased extension of the other pair of feet; but even when the above favorable extension occurs in a horse to excess, the probability of a good gait on the stretch is also in question.

My experiments were made mostly with the object in view of keeping the distances of correlated feet alike and of holding any one *excessive* extension as being a menace to the safety and soundness of the horse. In the trials of animals owned by me I allowed myself a little more liberty of ascertaining the effects of various conditions imposed for that purpose. It is, however, not my advice to the reader to try indiscriminately the shoeings noted down, but rather to make changes only when called for by the analysis of the gait, and to do so gradually. Much of the necessary change may be temporary only, and

if there is a permanent inequality necessary there must be also a permanent structural fault somewhere. The two front and the two hind feet may not always be alike either in size or in growth of toe or heel, so that after three weeks from the date of shoeing the horse may again be out of balance; or, on the other hand, it may be just this inequality in toe length and angle that may cause a better way of going at the end of those three weeks. Hence arises the advisability of accurately observing the actual conditions, small in difference as they may seem, of the four feet at such a period of apparent balance.

While, therefore, it may be said that more weight on front feet increases the action rather than the extensions of same, when both feet and shoes are alike, any inequality in length of toe or in angle or in shape of foot may have a different effect, as seen in other experiments. Besides, there is always the influence of the hind extension on the fore which may induce the fore to respond to it, so that the fore cannot be said to act or extend quite *independently* and vice versa, the increased activity or extension of one fore leg influences the diagonal or correlated hind leg in its movements and extensions. This interrelation of the feet is one of the most difficult points of balance to adjust, and will always have to be taken into account when trying to regulate the movements of one particular leg. We cannot always say that one correction will influence just one particular foot, because it generally reflects on the action of the correlated foot as well. Having the weight and shape of shoes under consideration, I shall now endeavor to show the effect of unequal weight in front and also that of the squared toe. However difficult it may appear to understand this relation between the fore and hind, the effect is readily seen in the results of shoeings such as here given.

A gelding by Nutwood Wilkes will serve as a subject for unequal weights, angles and toes. The peculiarities of his gait were the excessive extensions of near fore and off hind. The near fore was dished at toe and would naturally point forward, and the off hind was in consequence interfering with off fore and got into the habit of going in between the paths of the two fore feet, or inside of off fore.

Fig. 158 gives a shoeing intended to correct these tendencies of

excessive extension. The result of the extensions is quite unsatisfactory, because it shows the pacing or single-foot habit of extensions. The fore were corrected by a heavier shoe and greater angle on the near fore, increasing the action and elevation of near fore and de-

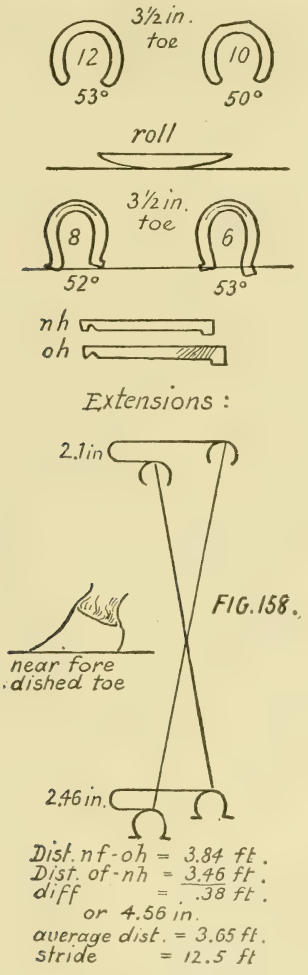


FIG. 158.

creasing its extension in spite of the off hind being still more extended than near hind.

The square toe of the right fore, in this instance, facilitates the leverage at toe and the lower angle favors a better extension. The variations from general average stride show the off fore to be the freer

and more active leg, because their scope is greater than that of the near fore. Behind, the off foot was not fully corrected by either lighter shoe, greater angle or longer and more swelled heel, for it still retained its extension over that of the near hind. Because of this persistent habit behind, the gait was not fully satisfactory and correct. About the longer heel behind we shall later have more to investigate, but it may be mentioned that most experiments showed that longer hind heels (compared with the heels of opposite hind foot) will strike ground sooner, and the foot, to avoid a shock, will be carried to a greater forward extension. With merely thicker heels this seems not to take place, but the backward reach is rather facilitated thereby and the extension lessened.

In Fig. 159 we have such a correction for the hind, but the near fore is again too active. This is due to lowering the heel from 53° to 50° and squaring toe. There is no doubt but what the squared toe of the shoe will bring about a readier action than the ordinary round toe, and it is this quickened action which, when properly directed by weight and angle, can be a great benefit to the horse. Squared toes, in general, tend rather toward greater elevation of action, other conditions being equal.

In Fig. 159 the squared toes on fore had not the desired effect on the gait of this horse, because he was naturally rapid gaited and possessed little of that desirable forward reach of the front legs that counts in speed. It will be noticed that the average distance of correlated feet is less (3.32 ft.) than it was in Fig. 158 (3.65 ft.), showing the effect of squared toes in front. Hind toes were about ⅛ inch shorter than front toes to check in a measure the forward extension of hind, which was his great fault. The off hind, though restrained by thicker heel and greater angle, and set back by easier action of near hind due to squared toe, was still in evidence as a "pointer;" but even then its natural relation with the near fore did not make it extend excessively. This shows the effective way of shoeing behind in this case. The greater weight on near fore does not show the effect of less extension, because of the peculiar formation of that foot, it being dished

at toe and prone to point forward, unless kept at a much steeper angle, as in Fig. 158.

Let us follow the shoeings of this gelding in their various applications. Three weeks later we have the shoeing of Fig. 160. Leaving off the extra weight from near fore and increasing the angle, as well as swelling the heel of that shoe, did not improve or rather check

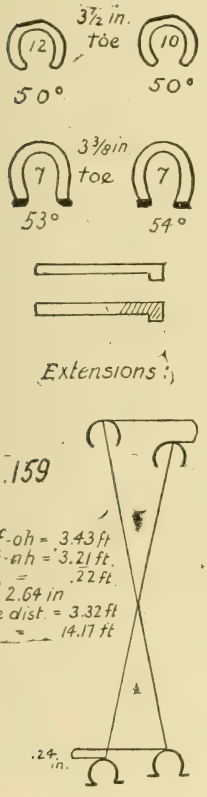


FIG. 159.

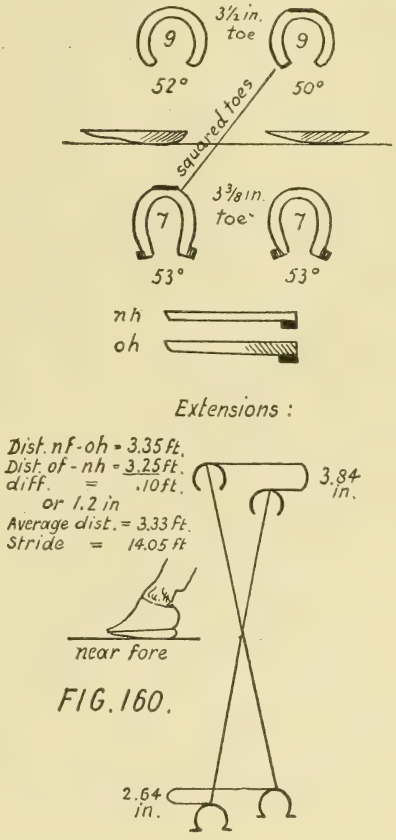


FIG. 160.

its extension, but did increase it. The off hind also shows increased extension due no doubt to a lower angle (54°-53°). In this case the round toe of near fore has the advantage over the square toe of off fore, and the extension of same is also increased by the difference in the roll of shoe, the near fore having a quicker or forward roll from heel to toe, while the off fore has an equally divided roll from middle to

both heel and toe. Besides, its greater extension draws with it the off hind in this case. In this shoeing the feet with the square toes follow behind those with the round toes. We shall refer to this again in other cases.

In the shoeing of Fig. 161 the squared toes were reversed; that is to say, the other pair of correlated feet were so shod. The result

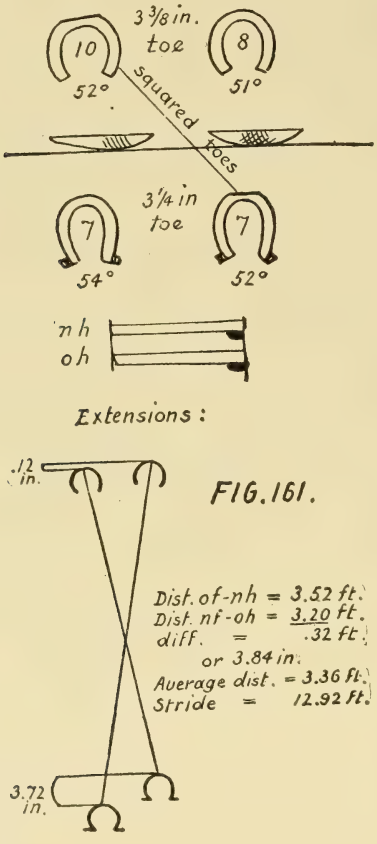


FIG. 161.

shows a decreased extension of the squared near fore and a somewhat increased extension of the squared hind. We should, however, take into consideration the lesser angle of off hind foot, which difference would in itself tend toward a greater forward extension. We can notice the effect of weight on near fore and also the direct effect of squared toe, but behind this is not so evident. The off hind was always

the most active foot and the square toe, together with the consequent higher action caused by same, and the influence of the higher elevation of its correlated near fore, increased the greater extension of the off hind. It is noteworthy that the effect of near fore on off hind is neither in this nor in the previous shoeing as great or at all as visible as was the effect on the fore by the hind, as illustrated in previous shoeings.

B.—Longer Heels on Hind Shoes With And Without Squared Toes.

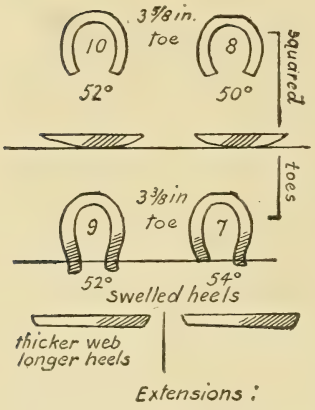
The squaring of the toe of the shoe, other things being equal, has the effect of a readier leverage at the toe and a shorter time-contact with the ground; and it makes the foot more responsive to the influence of weight and of angle of toe. If one foot only is squared at either or both extremities, its elevation will be increased and its extension will be, as a rule, somewhat checked, much depending on the difference of angle, of weight of the shoe and of length of toe, as compared with the other foot.

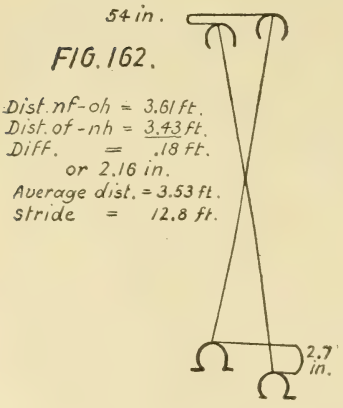
In all of these experiments erroneous corrections are bound to appear as judged by a better or worse extension of correlated feet. The combinations possible to make are very numerous, and therefore are apt to lead to error unless the results are critically compared. After eliminating the error so made, there will still be ample facts left to establish certain general deductions and rules which, when carefully applied, will yield the corrections for a defective gait.

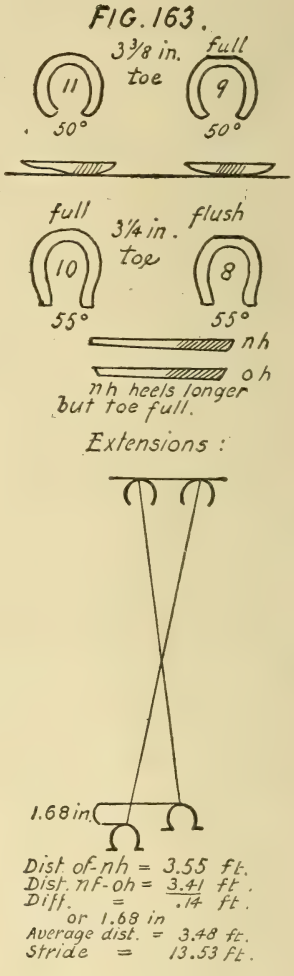
Squaring the toes of correlated feet has often led to the straightening out of equine locomotion. Another direct effect on hind extension is brought about by comparatively longer heels of shoe on one hind foot only; and such effect will also be shown in some of the experiments offered here.

Fig. 162 gives a modification of the shoeings of Fig. 160 and Fig. 161, principally in regard to weight and angle. A comparatively longer heel on near hind proves to have the effect in this case, as well as in others, to increase forward extension. We shall for the present deal

with the longer heel in conjunction with a round toe. The longer heel does not come under Roberge's rules of pointing apparently, for these refer only to a high and a low heel. A long heel is especially effective with a lower angle as compared with the opposite foot, as shown in Fig. 162.







It has always seemed to me that such forward extension is caused by a lessened elevation, as well as by a greater "ground surface," as the shoer calls it. I do not quite share this view of the longer surface causing an increase of extension by itself, though it may add its

mite in that direction. It seems more rational to explain the cause of such greater extension by the endeavor of the animal to avoid a shock such as a long heel will in a measure produce, and to equalize the touch of heels on ground by reaching out farther with the foot which carries the longer heels; especially if its angle is lower.

In Fig. 162 the lower hind angle (52°) and the heavier weight (9 oz.) lend their assistance toward a forward extension; and, on the other hand, the greater angle (54°) or higher heel with the lighter weight (7 oz.) tend to retard the extension of the opposite or off foot. The square toe in this case tends to elevate the action, while the round toe tends to lessen the elevation. In front we have again the near fore restrained in extension by greater weight and angle, even though the off fore has a squared toe. In both these front extensions there is again visible the influence of the hind action, the off hind still further restraining the near fore and near hind giving impetus or activity to the off fore.

Continuing with the same subject we have the conditions of the shoeing of Fig. 163, which are practically the same as in Fig. 162, except for the shorter toes of fore and of hind and more particularly the difference in angles between fore and between hind of both shoeings. This difference in angles stops the extensions of both right fore and left hind and gives the active right hind a chance to assert its habit of forward extension, as in Fig. 161, but in a much smaller degree.

Weight restrains the left fore and helps the left hind (Fig. 163). The shoes of right fore and left hind being set full, the extension is also helped thereby. In the variations from average stride both fore were nearly alike in steadiness, and the left hind was much the steadier of the two hind. The shoe of the right hind had the heels a trifle thicker than the left hind and this may also have caused a quicker break-over at toe. The difference in hind extensions, however, was considerably less. At any rate, the variations from average stride were too great in extent to endorse this shoeing as correct, and the trial showed it somewhat. Let us pass on to another shoeing in Fig. 164. The main point here is the difference in toe-lengths of hind

feet, and the forward extension of off hind with its squared toe is so excessive that it is well worth noting as compared with the near hind with the shorter foot and longer heels on the shoe. Here, again, the longer foot of the off hind is more effective in greater forward extension. Incidentally, I may remark that certain manipulations or changes, such as a squared toe or a longer heel, do not *always* work out the expected improvement or pre-conceived plan of correction because certain auxiliary conditions are not *always* the same in the opposite or diagonal foot. That is very often the reason why the effect is contrary to expectation at times.

Here (Fig. 164) we have intentionally lengthened the right hind foot, squared the toe and swelled the heels a little more than those of left hind, and we have also given the left hind shoe longer heels and a round toe. We have, therefore, increased the breakover of the right hind and made it more difficult for the left hind. Again, we have raised the heels of the left fore slightly, and though somewhat influenced by its diagonal mate, the right hind, it shows no excessive extension in consequence. The speed of the horse was greater, as the stride will show, and the variations of the movements of the legs from the average stride were less in extent but similar in manner, showing the steadier movements to be with the right fore and the left hind. The gait may be said to have been spoiled by the over-active and unsteady right hind leg.

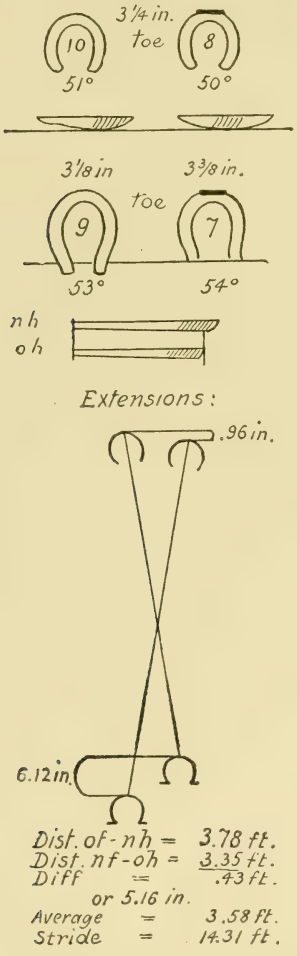
On the whole the result shows that the adjustment of the near hind did not counteract the tendency of the off hind to reach forward. The effect of the squared toe of the latter was towards a higher action, which again was converted into a greater forward extension partly by a longer foot (3⅜ in.) and partly by a confirmed habit. The greater weight and longer heels of the near hind shoe did not, therefore, in this instance check or offset the activity of the off hind leg.

A similar instance of habitual extension with one hind leg we saw in a gelding whose shoeings were described in Figs. 137-144, some of the shoeings omitted there being now given to show similar effects of a *squared toe with a longer foot and with longer heels,* as

with the subject here discussed. It will be remembered that this gelding's off hind foot had a short forward extension and that weight, angle and length of foot finally brought about an improvement of gait.

The omitted shoeings now given will further illustrate the effect

FIG. 164.



of squared toes, longer heels, longer foot and various angles. Before arriving at the effective shoeings of Fig. 142-143 these shoeings were tried in the endeavor to eliminate the hop or rough gait of hind legs. Though erroneous as a remedy they will nevertheless illustrate the points now under consideration.

In Fig. 165 appear two squared hind toes, the near shoe having the longer heels and both having calks. The activity and extension of the free near hind leg is intensified by the calks and the longer heels and the distance between extremities (2.56 ft.) is too small for the length and height of the animal. The gait was very faulty.

FIG. 165.

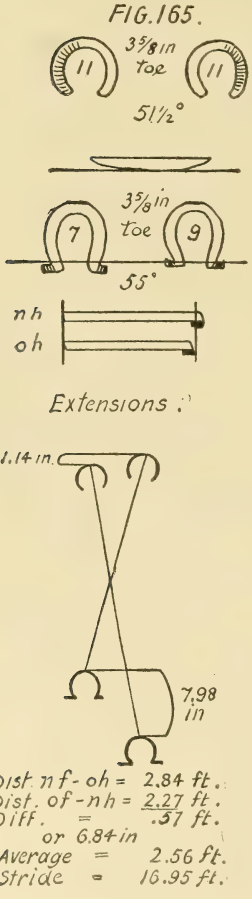


FIG. 166

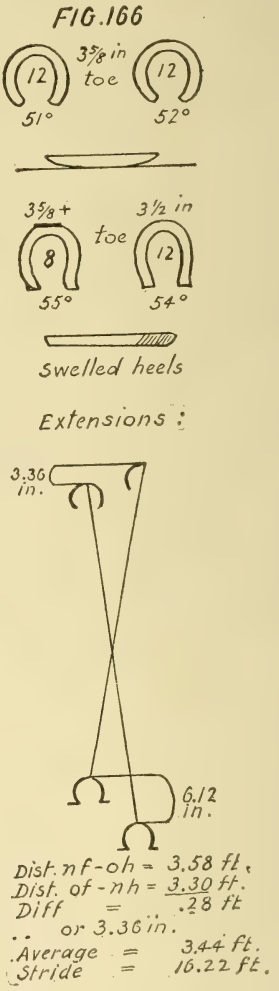
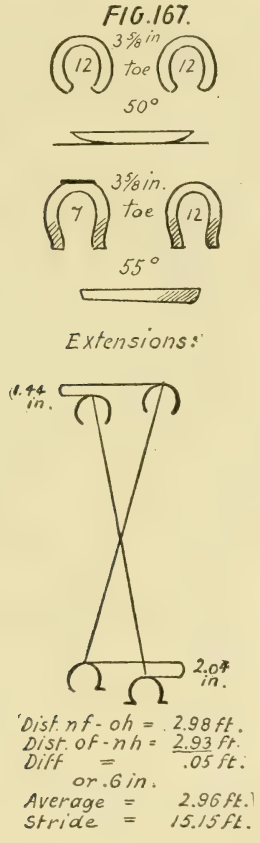


Fig. 166 is another shoeing with near hind squared at toe and with greater length of toe (3⅝+) and height of heel (55°) than those of off hind (3½ in. and 54°). Hence near hind was really the longer leg and, with an easy leverage at the toe, was therefore more

readily extended forward. The swelled heels on both hind, however, tended to increase the distance between extremities (3.44 ft.).

An intermediate effect of squared toe on near hind, as compared with the two previous results, occurs in Fig. 167. Here the squared toe checks the former greater extension of near hind with reference to the equally long off hind. The distance between the extremities (2.96 ft.)



is greater than in Fig. 165 (2.56), but still less than in Fig. 166 (3.44). In Fig. 143-A this distance was also relatively small (2.88 ft.), but in Fig. 143-B it is increased to 3.59 ft., and the whole question of separating the extremities reasonably to insure a free open reach in front hinged on the easier forward extension of the left fore leg. Not only was this effected by the increased extension of off hind, as in Fig. 143-B, but also by the *longer toe and lower heel* (50°) of that near

fore foot; and though subsequently in Fig. 142 (one month later) the final greater extension of the near fore and off hind, as effected there by angles and toe-lengths, was somewhat excessive, it was more in line with the requisite extensions for the turns of the track. It proved to produce a good regular trot.

Again referring to Figs. 145 and 146, we notice the extension of the off hind foot with the squared toe, and compared with the extensions of the previous shoeing of that gelding this squared toe checked the excessive previous extension which showed the remarkably faulty difference of 10.92 inches—the distance the off hind was carried ahead of near hind. This facilitated the movements of the near fore, which leg had a bad tendon. Checking the extension and increasing the elevation of the off hind by the squared toe and greater angle checks the near fore in a measure and the near hind of that gelding being also affected in the hock, we have the strange phenomenon of excessive extensions on the off side. Such a twist, one might say, to the movements of the legs cannot at any time augur any good, and it is wise to either discontinue training or devise more effective and yet safe means to bring the extensions into harmony and let at least the distance between the correlated feet be approximately the same.

Reference is here made to a series of previous illustrations under Figs. 96, 99, 106, 109, 111 and 113, in which the *off hind* carries a shoe *with longer heels*. In both 96 and 99 the hind shoes remained the same, the shoeing of 96 following in reality that of 99. As the hind shoes were made and fitted by another shoer the accuracy of data given can not quite be depended on. On the other hand, the tendency at previous trials was a greater or excessive extension of the opposite or near hind leg, so that this habit may have remained for some time after. Such a remnant of previous conditions always presents a disturbing element in subsequent shoeings. At any rate, the longer heels on off hind did not materially increase the extension of that leg, but in the subsequent shoeings, as illustrated in the remaining figures above alluded to, there appears a more decided influence of these long heels on the off hind shoe, namely, they increase, as a rule, the extension. Besides, the application of the so-called Memphis

shoe in front, with its two bars straight across the shoe, was in itself a mistake for that subject, because it increased the elevation of the front action, which was naturally rather high. Elsewhere I have tried to show that excessive front elevation is likely to produce a low and more direct forward action of the hind feet in which any greater weight on the hind shoes will show by greater extension. In the

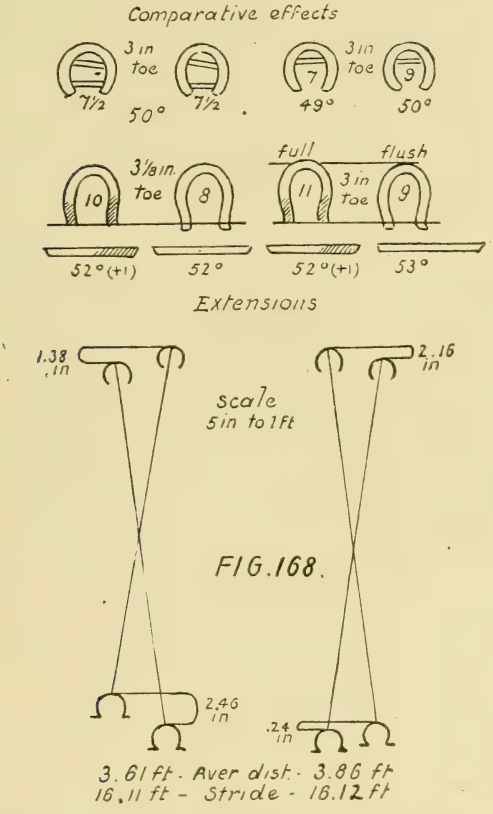


FIG. 168.

shoeings of Figs. 96 and 99 this effect can be noticed and will explain again the reaching forward of the near hind foot.

In this connection let us compare the shoeings of Fig. 96 and of Fig. 106, the latter being, however, *without toe-weights,* and a separate trial. The first half of Fig. 107 gives its results. I shall place them alongside of each other in Fig. 168 for a better survey of the matter in hand. The comparison is apt because the stride in each

trial was about the same (16.11 ft. and 16.12 ft.). With the Memphis shoes and even angles at both extremities and the front toes 1/8 in. shorter than hind toes we have an average distance between the extremities of 3.61 ft., while with the modified shoe of only one crossbar near front toes, and with all feet at 3 in. toe-length, we have the same distance at 3.86 ft. The difference or the greater separation being, therefore, 25 ft. or 3 in. in the latter trial. Incidentally, I may remark that the Memphis shoe is not to be rejected because it did not suit this high-gaited mare. Other horses may be greatly benefited by it; but there is one objection to the shoe in any case and that is the difficulty to make it and the bending of the bars upward against the sole of the foot.

The difference of time between the trials was about 35 days. The principal change of extension is no doubt due to the change of front shoes and the shifting from off to near side in pointing forward with fore is due to the difference of angles and weights, the light shoe with lower angle preceding the heavier shoe with greater angle. The pointing of the fore influenced the hind action to some degree, so that near hind was set back thereby; but the difference between hind extensions is but very slight (0.24 in.), and surely far less than it might have been if the increased weight and the full toe on near hind had been left out. As it is, and in spite of such conditions, the effect of longer heels on off hind is visible, even though part of its extension is due to the influence of the near fore, or its diagonal and correlated mate.

The remaining trials under Figs. 109, 111 and 113 followed that of Fig. 106, *without toe-weights,* where the extensions were given under Fig. 107. Coming under the head of "toe-weights" they were shown in order to understand the peculiarities of the subject used. We shall now recall the results with a view to analyzing the effects, especially the effect of the longer heels on off hind shoe. These three shoeings differ from Fig. 106 principally by the lower angle or heels of front feet and lighter weight of hind shoes. For easier comparison the shoeings are grouped again in Fig. 169 and their extensions in Fig. 170.

In speaking of these shoeings in the paragraph on toe-weights mention was made of the various effects produced by certain conditions. The best gait and the best speed were found to exist under conditions of B in both of these figures, and this was caused mainly by the greater length and reach of right hind leg. In this result the

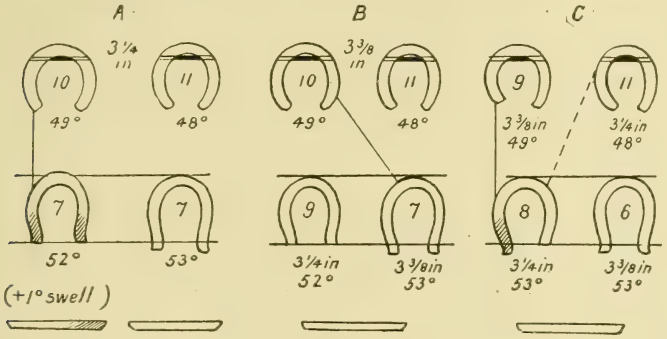


FIG. 169

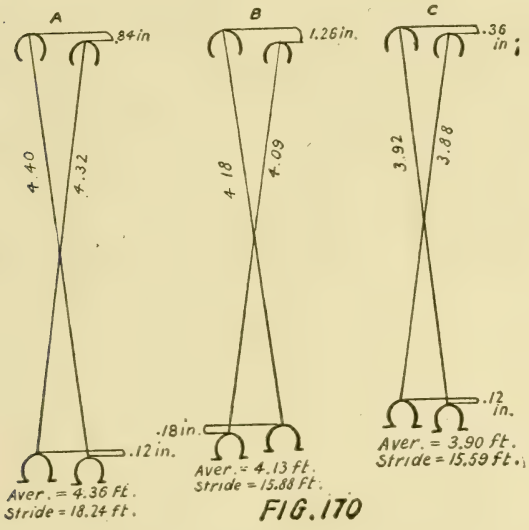


FIG. 170

longer heels of shoe played a good part, but at the time of the trials it was still puzzling to me how to stop the uneven extension behind. The weight on near hind was meant to increase extension, but at the same time the longer heels on off hind were *supposed* to check extension. Later investigations proved the latter idea to be an error,

while the weight on hind was correctly placed. Therefore, in the trial of B, the longer off hind foot and its longer heels overcame the weight and lower angle of the near hind foot; while in C it did not succeed in doing so because of the longer near fore, which is checked by greater length of toe and greater angle as compared with off fore. This check causes a further reduction of the distance between fore and hind feet from 4.13 ft. to 3.90 ft. I may here remark that such a check to near fore is at all times dangerous and productive of injuries because, as before mentioned, the greater extension is naturally with the near fore on account of taking the turns.

Again, in C the off fore, though lifted and helped by greater length of near fore, does not extend as much on that account because of its greater weight in shoe. The effect is therefore greater in elevation, but the lower angle should give it a chance to extend. All these combinations, though somewhat counteracting each other, can be said to have brought about the action and extension of the off fore.

In A the angles of hind are practically the same, the swelled heels of near hind making up for lesser angle of the foot proper. With full toe of shoe the extension would naturally be slightly more; but whether swelled heels had any part in that other examples will make clear in a subsequent paragraph. The greater separation of fore and hind is no doubt due largely to lighter hind shoes, but in some measure also to the longer stride of 18.24 ft. The endeavor with the front shoes was principally in the direction of equalizing the extension between the near and off, counteracting the weight necessary for the paddling off fore by a lower angle of that foot.

We shall consider the subject whose last shoeing was given in Fig. 164 and once more see the effect of squared toes.

The case considered from Fig. 161 to Fig. 164 inclusive was that of a peculiarly and rapidly gaited gelding. There was a preference for a near fore greater forward reach or extension—the foot with a dished toe and high heel—due, no doubt, in part to the paddling of off fore; and, furthermore, there was an over-reach of off hind foot which, on account of interference with off fore, was placed more or less inside of the latter.

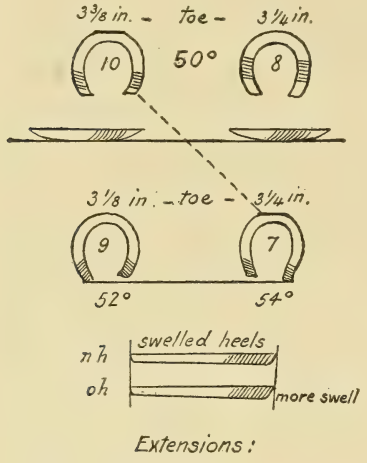
Ordinarily, it is considered a sign of a "short stride," as it is erroneously called, when a hind foot is placed between the two fore feet; that is to say, the extension of such a foot is considered to be deficient. In this case the reverse was true, for the off hind did actually have a greater forward reach or extension than the near hind. Again, I would like to point out the necessity of exact measurements and of the averages derived therefrom, because on ordinary suppositions the off hind would have been considered a leg with a "shorter stride" or of a lesser extension. The fact that the reverse was true made the subject rather a hard case to handle and one not readily amenable to correction.

The squared toe was considered a remedy in such cases and the few corrective shoeings here offered did in a way show what could be done in similar cases. The variety of changes in this as well as in other cases may remind the reader of the sensible rule in experimenting, namely, to vary only one thing at a time. But here, as in other cases, the expectations from every change were so great on the part of the persons interested that the array of conditions in the shoeing seems rather confusing. The reader being, however, somewhat familiar with the influences of such conditions, the main point at issue—squared toes—may, therefore, be dwelt upon with more emphasis.

Here, then, is a case where rapid gait and deficient extensions caused a great deal of that disturbing motion in front which might be called "recovering," from the fact that one leg tries to make good what the other one loses in motion; and, again, behind we have in consequence an attempt to get around the fore legs which manifests itself in hopping or shifting from one side to the other.

The few illustrations here offered may show the effect of corrective shoeing, more or less, but the fact remains that the horse was a very hard case to get satisfactory results from. In Fig. 164 was given a showing under date of June 14, and under Figs. 171 and 172 are now given the successive shoeings of the trials of July 6 and August 4. The main endeavor was to reduce the extension of the near fore and off hind to within reasonable limits by means of squared toes on shoes.

We have in Fig. 171 still a greater forward reach of the off hind because the effect of the squared toe was partly nullified by the greater length of toe (3¼) than that of the near hind (3⅛), in spite of the latter's greater weight and lower angle. In front the squared toe and greater weight of near shoe restrain somewhat the extension of near



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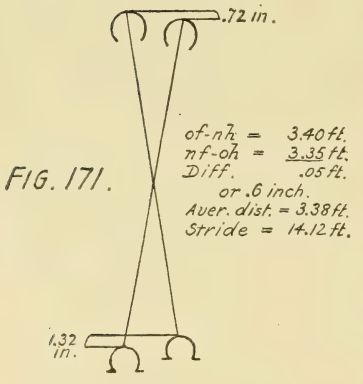
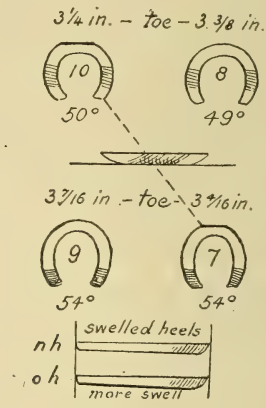


FIG. 171.



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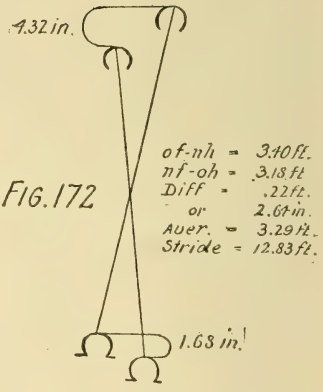


FIG. 172

fore and the slightly longer toe (⅛ in.) with higher heel of shoe (as per section) have the same tendency to check extension. The difference between the distances of the correlated feet gives but 0.6 inch, which is negligible; so that the gait and extension proved fairly satisfactory. In the variations from the average stride there was rather a strong effort of the off fore leg to make up for the greater reach of

near fore; and behind, the off foot with the squared toe varied more, which means that in spite of its greater and habitual extension the off hind was not the stronger or more regular leg. Therefore, the primary effect of the squared toes thus applied to the pair of correlated legs whose extensions are excessive (nf-oh) would seem to show a restraint or check.

In the next change of Fig. 172 the lengths of the toes in front are reversed and the angle of off fore lowered one degree. The object of a longer toe and lower angle or heel is to increase the *pointing forward* of off fore; while the near fore not alone has a squared toe but a heavier shoe with a slightly thicker web. The angle of near fore is 50° as against that of 49° of off fore, and the front shoes are both alike in shape. In the previous trial this difference of angles was effected by the shape of near front shoe being slightly higher or thicker near heel. (See Fig. 171.) Behind there is quite a difference in toes, the near hind having 3/16 inch more toe length. The angle of foot being the same on both hind, the near may be considered the longer leg on account of a longer toe and a correspondingly higher heel in consequence. This fact as against the squared toe and the shorter foot of the off hind brings about a result which, though it was corrective in extensions, was somewhat destructive of speed at that particular trial, as the short stride of 12.83 ft. will illustrate. A few days later, however, he showed good speed and balance, going a quarter easily in 35½ seconds. It seemed as if the restraint put upon the excessive extension was modified by the growth of feet so that the result was pretty satisfactory; but in order to show his reverting to the previous way of going the same conditions at the next shoeing were maintained *absolutely* as in Fig. 172, except that *round toes instead of squared toes* were used on the near fore and off hind.

The resulting extensions are given in Fig. 173; and in order to show the directions of the four feet or their lateral extensions the actual distances from the median line are given in Fig. 174. Here, then, it is seen that a hind leg which is placed between the two fore must not necessarily be one that drags or whose extension is deficient. In this case, as in others, such a leg is too often active and causes

more damage and a more uneven gait than if it were deficient in forward extension; for, while such deficiency might be developed and

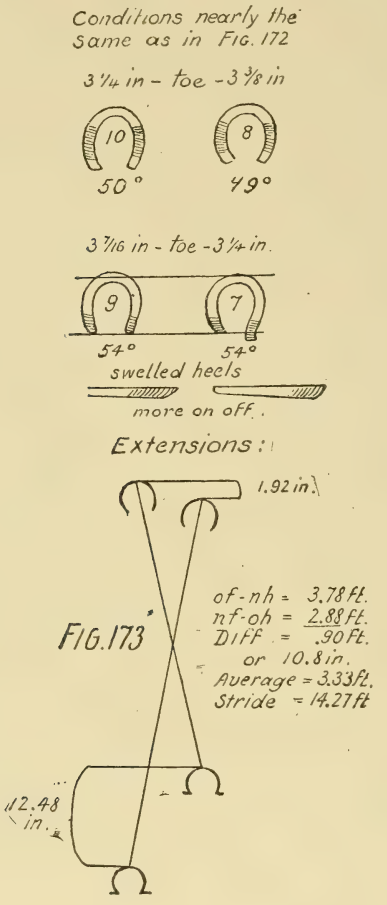


FIG. 173.

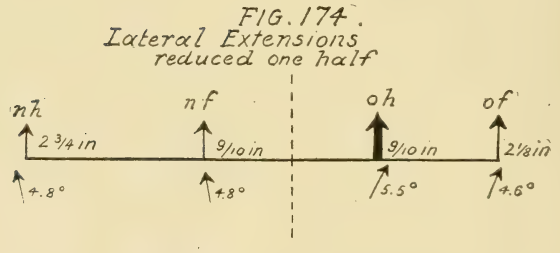


FIG. 174.
Lateral Extensions reduced one half

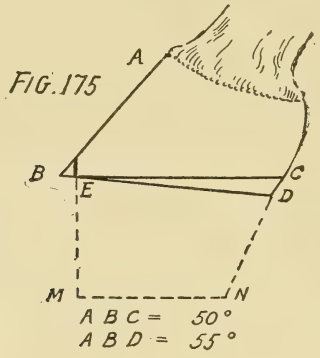
directed toward the outside, this inward and forward activity is hardly amenable to treatment. When the extension is restrained the better

placing of off hind foot is not helped thereby, and so it was and remained a matter of limited improvement, beyond which the old habits of gait again asserted themselves. The squaring of the two diagonal toes—near fore and off hind—may be said to be the solution of this problem. Disturbing elements entered even into these shoeings by faulty lengths of toes and angles, but the principle of the two squared toes seemed to be quite correct. For instance, the extensions of near fore and off hind were once nearly the same (0.78 ft. and 0.88 ft.), but there was an impact or beat on ground louder with the round toe feet than with the squared toe feet. This time beating or rhythm sounded like the movements of a lame horse, and it was no doubt due to the fact that the squared toes had a higher action and elevation than the feet with the round toes, which made the latter to reach the ground sooner than they should, causing thereby an irregular rhythm in the motion of the two pairs of correlated legs. Such irregularity, however, could be adjusted by shape of feet and greater weight of one shoe.

Granting that, other things being equal, the squared toe shoe will cause an easier and quicker break-over of the foot in question, as well as a higher rather than a more extended action, it should be borne in mind, nevertheless, that when between two fore or two hind feet the conditions are otherwise unequal, such as a higher heel or a heavier shoe on either foot, there may result a slightly greater extension of the foot so shod. For instance, a higher heel with the squared toe shoe would diminish the ground surface or rather the length of the shoe, and would, therefore, shorten the contact with the ground of that shoe or that foot so shod. It will seem, therefore, that a foot shod thus differently from its opposite mate will have greater action than that other opposite mate; that is to say, the action becomes easier because of that easier break-over due to the shorter length of shoe and foot. Any influence added to a foot so pared and shod will, therefore, be more readily visible, whether it be the diagonal influence of a hind foot or a toe-weight or heavier shoe on the fore foot so shod. An illustration to that effect may be found in Fig. 175. Here A B C represent a foot with an angle of perhaps 50°. Squaring the toe as

at E and increasing the angle to 55°, as at D, we have the foot A E D as against that of A B C. The dotted lines extended to M and N indicate the effect of the reduction of surface contact by means of the squared toe *and* the higher heel, and the line MN shows in an exaggerated manner the evident tendency toward a shorter ground contact.

Whatever may be the greater *extension* of a foot so shod, if any, it is primarily true that the *elevation* is greater in any event. Whatever time is gained by shorter contact with the ground is spent in action. High heels and squared toes are to a certain degree good preventives of strains, and the combination acts in a way like a rolling motion shoe, for it avoids the anchoring of the toe and quickens the leverage from the heel on account of the higher position of the lever



at the heel and of the shorter length of the lever itself from heel to toe. But at the same time we should not forget that the horse needs a sufficiently long contact with the ground to enable him to use the toe effectively in the effort of propulsion. In order to have that effective leverage—neither too short nor too long—it will be necessary to regulate the action of the leg according to Figs. 15 and 16, where an equal forward and backward extension was considered a primary condition of a gait without lost motion.

All the various corrections by means of angle, length of foot, shape of shoe and other adjustments must have this primary condition always in view, and this condition must be followed in each case, however different the remedies for various faults. For, broadly considered, no matter how differently gaited horses are in their manner

of going at the trot or the pace, the regularity of either gait can only be accomplished by such equal extensions. It may, therefore, be true, as heretofore mentioned, that every remedy does not apply to every horse, yet that does not mean that each horse is an absolute case by itself, but rather that each horse has peculiarities and faults whose corrections may be accomplished by always having in view this primary condition of the equal extensions of all four legs.

This condition, however, of equal extensions also applies to the averages of the measurements as exemplified in the various cases given, but mainly to the equal forward and backward swing of the legs or feet. The eye must, therefore, decide first whether the action has this regularity of motion, and the method offered to ascertain the gait as found on the ground must go hand in hand with that judgment of the eye; but by the calculations of the + and — variations from average stride, as given on pages 140, 159, 188 and 195, we can also determine if there is such an equal swing of the leg. My observations and experiments tend to prove that these total positive and negative variations indicate such forward and backward extensions; and the more nearly equal these variations are, the more equal will be the forward and backward swings of that leg. A study of the variations heretofore given will make this more clear.

The influence of a foot trimmed or shod as given in Fig. 175 became evident in the experiments of the last case given. The combination of a squared toe and a high heel appeared to have eventually an accelerating effect and with that over-active off hind leg, as in the last case, it proved to be not as effective a correction as anticipated.

We have seen that hind shoes with squared toes and calks had a better effect to increase elevation and decrease extension than perhaps the squared toes with swelled heels had, which no doubt is due to the prompter check to motion which calks are apt to give.

With the effect of shoeing under Fig. 173 carried over to the next shoeing we have in Fig. 176 the subsequent adjustment of shoes and the resulting extensions. The stride in both trials was practically the same (14.27 ft. and 14.23 ft.) Note the same off hind excessive extension. There was therefore, apparently, no difference between

the round toes of Fig. 173 (near fore and off hind) and the squared toes of Fig. 176, except in degree.

Comparing these two diagrams we find that the near fore with

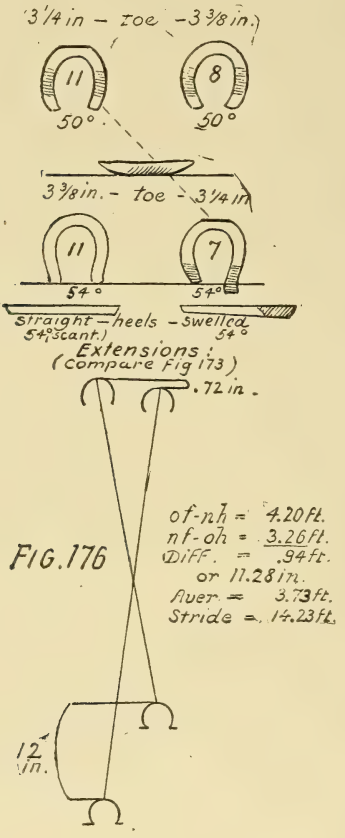
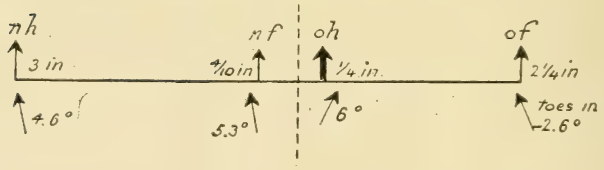


FIG. 176

FIG. 177
Lateral extensions reduced one half.



the round toe extends 1.2 inch (1.92—0.72) more than that with the squared toe, and the off hind with the round toe extends 0.48 inch (12.48—12.) more than that with the squared toe. The shoeing of

Figs. 173 and 176 is nearly the same in detail, except in angle of off fore, in weight on near side, and in *shape of hind shoes* as well as *greater length of near hind* in Fig. 173 or the previous shoeing. The separation of fore from hind feet, or the average distance between them, is greater in the last shoeing (3.73 ft.) by 4.8 in. over that of Fig. 173 (3.33 ft.)

The stride in each trial was about the same: 14.27 ft. and 14.23 ft., but the variations of both the fore and the hind legs from these average strides were much smaller in scope, or more regular, in the second trial (Fig. 176), and the reason for this greater regularity seems to lie in the fact that both the near fore and the off hind had squared toes, as in Fig. 172. This caused the higher action and the somewhat lesser extension of these two feet. Now, we find, in comparing the differences of the separations between the feet which move together, that in Fig. 176 these are both greater than in Fig. 173; that is to say, the near fore and the off hind are separated more by 0.38 ft. (3.26—2.88) or 4.56 in., and the off fore and the near hind are separated more by 0.42 ft. (4.20—3.78) or 5.04 in. The sum total of these differences divided by 2 gives us 0.4 ft. or 4.8 in. as the difference between the average distances in both cases (3.73—3.33).

The main reason for this greater separation is undoubtedly due to the different adjustments on the near hind foot in these two trials. Its shoe in Fig. 173 is set full at the toe and has swelled heels, while in Fig. 176 it is set even at the toe and has flat heels. Besides, the near hind foot in Fig. 173 is longer than in Fig. 176. All of these conditions would favor a greater forward extension of near hind in Fig. 173. My contention has always been that the influence of one such different adjustment on one foot will often cause an entire change of extension or of gait. Swelled heels without calks have their drawbacks, inasmuch as they are apt to slide and thereby increase the time of contact with the ground, which hinders the horse from having prompt and free movements. Again, they are also apt to increase the forward extension when used in conjunction with the squared toe. When the swelled heels are *short,* they are also aided in this forward extension by the somewhat easier break-over,

due to the incline of the shoe from heels torward toe. They do not, therefore, form a part of a safe and suitable shoe; but at the time of these shoeings I had an idea that their use would, in general, correct the hind forward extensions. In a following trial we shall have occasion to see, after a fashion, again the effect of a longer rather than a higher heel, even though the heels on both were swelled heels.

Conditions in these two trials being, however, based on these swelled hind heels, the comparison between them may be considered a proper one, even though too many minor conditions or changes again figure in these trials. While in the previous trial (Fig. 173) the hind heels were somewhat different in their thickness, in the subsequent trial (Fig. 176) the *near hind shoe* was *flat,* while the *off hind* had squared toe and *swelled heels.* The near hind shoe was also heavier than before, which in reality increased the thickness of the web of that shoe. In spite of this, however, the extension of near hind did not exceed that of off hind. The reason for this seems to have been the easier break-over of the off hind, due to squared toe and swelled heels. This condition was discussed under Fig. 175. This distinct difference between the hind shoes and feet gives an idea of what counteracting effects we may have in our endeavors to get everything into harmonious motion. By the variations of the hind legs from the average strides the off hind showed in both trials—round toe and squared toe—an unsteadiness hard to account for, inasmuch as it appeared to be the most active and the freest leg. It was certainly extended ahead of its opposite mate, the near hind, and was not dragged after it as is the case of so many unsteady and hopping horses; nor could the near hind be pronounced a weak leg, because it was reasonably steady as to its variations.

In the trial of Fig. 176 the off hind varied quite a bit more from average stride, the totals of these variations above and below average being + 3.25 and — 2.60, while those of near hind were + 2.00 and — 2.16, the latter showing a pretty even swing of motion. Despite the fact, therefore, of the off hind pointing forward in excess and making the impression of a strong leg there is reason to believe that it really was unable, through some weakness of tendon or ligament, to extend

itself out behind, and its shifting to a position between the two fore legs was, therefore, a device of the horse to avoid interference. The mere fact of such position does not by itself argue any lack of forward extension, as is often taken for granted when the observation is made by the eye and not by actual measurements.

It was noteworthy to observe on the ground the *continual striking and slipping of the heels of the off hind,* particularly the outside heel, while the near hind showed at all the tracks a firm hold and a depression of the toe. This is the characteristic difference in signs between a foot that extends too far forward and one that extends too far backward. The power of propulsion lies largely at the toe and, therefore, the ability of the near hind to shove the ground from under it, as it were, gives the off hind the excessive forward reach. In other words, the two hind legs perform extreme functions, which an even or regular gait requires them to share equally.

Right here we might as well take into account the lateral extension of the second trial, or the way the feet travel as viewed from behind and measured from the standard or median line in the middle between the sulky wheels.

Fig. 174 gives the lateral extension of the previous trial and Fig. 177 of the following one. By studying both of these results an idea may be obtained of the importance of the proper lines of motion and how these are disturbed by one such faulty leg as the off hind in this case. While the near side is not much affected, save, perhaps, in the nearness of the fore to the middle line, the off side presents the reverse of what it ought to be and of what the near side shows. Here the off hind, by its inward line of motion, compels the off fore to step outside of it, or rather both fore shift from the near to the off side. The toeing in of the off fore is due to faulty paring of hoof, although the foot has that inclination if left to itself. The next trial will demonstrate the remedy for that faulty direction of foot.

Four weeks after the shoeing of the trial shown in the results of Fig. 176 this gelding was again shod with round toes on all four feet, as given in Fig. 178. Here we find the toe lengths of the fore feet the same, and that of the near hind longer by 3/16 inch than the

other three. With equally swelled heels on hind, those of the near are ¼ inch longer than those of the off hind. In paring the feet the angle of near fore is increased while that of the off fore is diminished

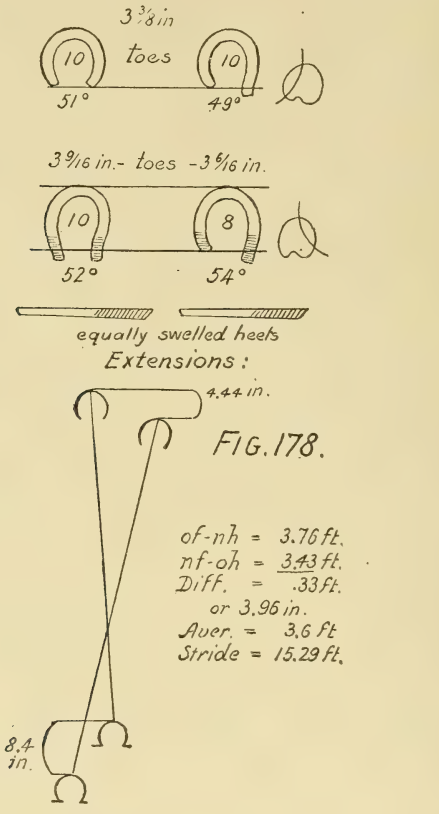
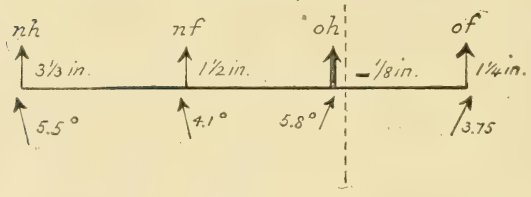


FIG. 178.

FIG. 179
Lateral extension of Fig. 178 reduced one half



one degree. Behind the angle of near foot is decreased to 52°. Front shoes are equalized each to 10 oz. and behind the difference in weight on near hind is also less, though off hind has one ounce more than in

Fig. 176. To counteract toeing in of off fore it is lowered on inside toe and given a slightly longer outside heel; and the toeing out of the off hind is corrected by lowering of outside toe.

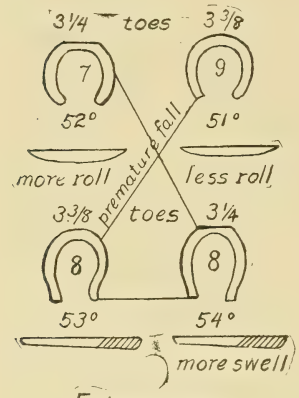
The change to round toes was merely an idea for the sake of comparing result with squared toes, but it would have been better if certain other conditions, such as angles and weights, could have remained the same. It is the same old story of trying to do too much at once, although the object in view was evidently to (1) check the extension of the near fore to some degree, and (2) to cause the near hind to extend more.

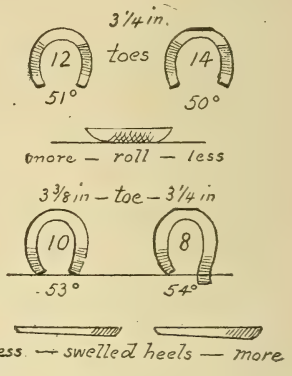
Set as the hind legs seem to be regarding each other's motions, the effort to bring forward the near hind affects the off hind indirectly so that the difference between the two is not as great as anticipated. Again we see the impression of toe in the near hind tracks and that of heels in the off hind tracks; also in front it was seen that the longer outside heel of the off fore had a *retarding effect.* It showed plainly at each track as having struck the ground harder than necessary. In both fore the toes showed a good toe impression, but those of the off fore were deeper and proved the greater backward extension of that foot. The *longer heels* of near hind no doubt had the effect heretofore discussed, namely, that of *increased extension.*

Looking at the lateral extension averages in Fig. 179 we see the off hind in a worse position than before, being on the wrong side of the middle line and still between the two fore feet. Paring it as indicated had very likely something to do with the position. In the variations from averages the off fore showed the greater activity over the near fore. It made the greater efforts, due, no doubt, to its lower angle and the influence of the near hind, which likewise varied more than off hind; but, as before set forth, the variations of the hind legs seem to be different in their indications from those of fore, inasmuch as the greater variations from the average stride belong to the deficient leg, while with the fore the most active leg has the greater variations from the average. Reaching out with the fore seems to indicate a desire for an increase of speed, while behind there is proof that the leg doing the least varying work is the best adapted for the propelling

power necessary for speed. The initiative in speed is sometimes taken by the fore, but the hind attend to most of the propulsion and for that reason more often start an increase of speed, while the fore more often put a check to speed.

My notes of this trial show the first evidence of irregular time beats between the pairs of correlated feet; that is to say, the off fore





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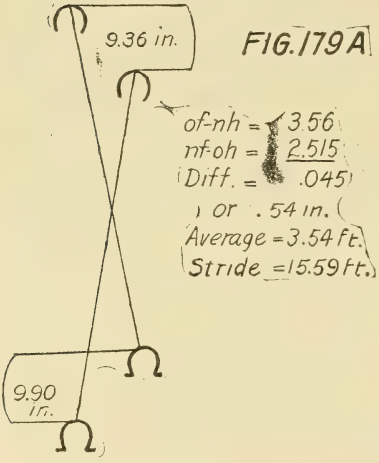

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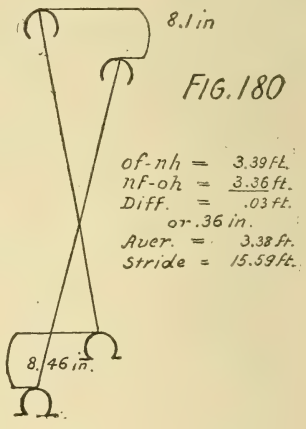


and the near hind seemed to strike the ground harder than the other two feet. There was, so to speak, a *premature fall* of the off fore and the near hind. Shortly after discussing Fig. 174 mention was made of this peculiar limp in the rhythm of the trot. There seems to have been a gradual increase of this irregular rhythm, and in a sub-

sequent shoeing—Fig. 179-A—to which reference was made, and which again shows squared toes on near fore and off hind, this limp between the two pairs of feet became still more evident to the ear.

At the next and last trial of the season my notes tell me that the gelding was going well (Fig. 180), but that he was liable to interfere on off side and would break in consequence. The distances of correlated feet were practically the same (3.36—3.39), and the regularity of the trotting rhythm left nothing to be desired while the good action lasted and until interference took place.

Mention has already been made of the danger of *excessive* extension by one pair of diagonally opposite or correlated feet. Here is an instance where equality of distance between these fore and hind feet had been achieved, but with too great an extension of one pair, viz., the near fore and off hind. Now let us look at the shoeing.

In Fig. 179-A the near fore is checked in forward extension by the roll and squared toe of the shoe, but again it is inclined toward extension by its foot being shorter (3¼ in.) than that of off fore (3⅜ in.). For the latter acts as a stilt for the greater extension of its opposite mate. Again, the higher angle (52°) was to correct the dished toe of the near fore as compared with the straight toe and lower angle of off fore; but in conjunction with the squared toe this greater angle seems to facilitate the break-over at toe. All in all, therefore, the greater forward extension of the near fore is almost a foregone conclusion, especially if we take into consideration the hind adjustment. Here we have, to begin with, the same weight in both shoes, but the longer toe on the near hind. Again, the higher angle and greater swell in heels of the off hind, together with the squared toe seems to entirely counteract the longer toe of near hind. The absence of greater weight in the near hind shoe does also not favor extension. We have, therefore, again everything in favor of a greater extension with the off hind, especially if we remember the habitual forward reach of that leg. There being such a habit, we need only recall the intimate relation existing between the feet that move together in order to understand the mutual influence of the near fore by the off hind.

My final experiment with this horse was, as mentioned before, that of Fig. 180. The difference in front weight was reversed and both angles lowered. The toe-lengths are the same. In both Figs. 179-A and 180 the roll of near fore shoe is greater than that of off fore. With a heavier shoe very often goes a thicker web, so that in the former trial the near fore was perhaps as long a foot as the off fore; while in Fig. 180 the off fore had a heavier and thicker shoe and hence greater length. Again, the heavier shoe on the off fore and its squared toe had the effect of increasing the folding of the leg and the elevation of that foot without increasing the extension.

The average stride in each case was exactly the same: 15.59 ft. The average separation between the extremities in these trials were: 3.54 ft. in Fig. 179-A, and 3.38 ft. in Fig. 180, which makes a difference of .16 ft. or 1.92 in. In other words, there is a greater separation where the squared toes occur diagonally across than where they are applied on the right side of horse. A glance at the total scope of the variations of the individual strides from the general average stride shows the greater disturbance in the second trial (Fig. 180). This proves that when the subject was allowed to follow his inclination, as in Fig. 179-A, the movements were less forced.

Let us look at the total scope of these variations in each case. We have:

	near-fore-off.		near-hind-off.	
Fig. 179-A	6.56 ft.	5.02 ft.	6.69 ft.	4.39 ft.
Fig. 180	9.00 "	5.71 "	6.40 "	6.05 "

In marking these totals as "feet" it is intended to call the reader's attention once more to the meaning of such variations. These totals comprise the sum of all the differences which each leg showed in all of its strides from the general average. The smaller these variations are as a whole the more regular will be the motion of the animal. In their relation to each other we have already learned that a greater variation in front denotes the stronger leg and the greater variation behind denotes the weaker leg; or, perhaps, it would be better to say that such a fore leg points forward more than its mate,

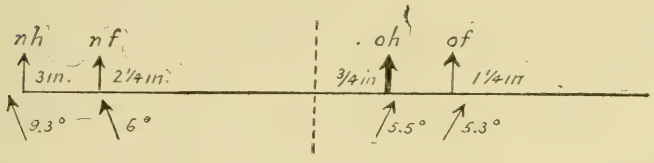
and that such a hind leg extends forward more easily than it points backward. In both these cases the near fore and the off hind act together in those excessive extensions. In the second trial we find the near fore a good deal more irregular, while both hind have approached to a closer equality of extension (6.40—6.05).

This horse, therefore, had a limit to his improvement in speed. He lacked the harmony of motion that is absolutely necessary for sustained efforts; but before the case is dismissed the lateral extensions of Fig. 180 should be examined as given in Fig. 181. They were averaged from 21 positions of each foot. The distances are given in inches as heretofore.

Again we have the unsatisfactory inward placing of the off hind, the other feet being in good position. The off hind should be at least two inches on outside of the off fore, not only to correspond with the

FIG. 181

Lateral extensions of Fig. 180 reduced one half.



other side, but also to conform to the general rule of lateral extensions for the trot. It is at times, on the stretch so measured, placed at distances, in inches, from the median line as follows: 1¼, 1½, 1¾, 2¼, ½, 4, ¼ and then drops inside the line to —1¼, —1, —¾, and so forth, showing the unsteadiness of a foot in danger of interference or actually interfering with the lateral fore foot. In studying the tracks laid out, as it were, before one's eyes, it may not always be expedient or possible to map them out as suggested, but it will be always advisable to go over them carefully and note anything abnormal in the contact with the ground. When the surface is good and smooth and the soil is not of the slipping kind, such as a sandy one, one may rest assured that the irregularities of the impressions, occurring as they often do with one particular foot, stand for some indication of a defect in action. For, as before asserted, the contact of the

foot with the ground, in order to be of the greatest possible effectiveness, must be *distinct, firm* and *light;* in other words, it must not show any blurred outlines due to premature fall of the foot, or any hard concussion due to a wrong direction or an unbalanced condition of the foot, or, again, it should not show any sliding or slipping of any part of the shoe. Where any of these observations are made repeatedly on one foot or more there is ample evidence of some disturbing cause, either amenable to treatment or due to structural faults beyond repair. At any rate, as "prima facie" evidence of a faulty gait such a close scrutiny of the tracks is much to be commended, even as a matter apart from any measurements and calculations at which many men may balk.

In the ordinary course of events, and with a commendable wisdom to avoid excessive toil, trainers are not apt to undertake the development of horses of deficient action and speed. Even with the horses of promise the education necessary for their appearance at the speed contests, or for their perfection as good roadsters, requires much close attention and labor. The inventiveness of the American mind forestalls drudgery, and it is ever intent on improvements along easy lines. But no one with an active mind and body can or should avoid the puzzles and perplexities of his vocation in life or the toil imposed upon him for the solution of such difficulties. Talent or aptitude for certain work is a man's real capital, but its income is increased only by the experience gathered through intelligent application and keen observation.

It was really beyond my purpose to try the patience of the reader by presenting so many experiments of my own, but my efforts to show the possibility of correcting a faulty gait will, I hope, prove the necessity of exact knowledge of a gait before remedies are applied. Errors which I have made in the combination of changes can be avoided by fewer and more marked differences, so that the cases given will at least serve as examples of a possible improvement in locomotion.

CHAPTER VII.

THE ANGLE AND LENGTH OF FOOT.

One of the main troubles of balancing a horse in motion lies in the ever growing hoof. Besides, the natural or rather often unnatural shape of it is in itself always an obstacle to success. The shoe can in a measure remedy the deficiencies, as has already been indicated, when a difference in size or shape between the fore feet or the hind feet appears. One of the most important and simple conditions of a good gait is a good foot on each leg and a close similarity, if not an exact equality, between the two fore and the two hind hoofs.

During the various investigations given it was necessary to take for granted that the reader was familiar with David Roberge's theory of pointing.

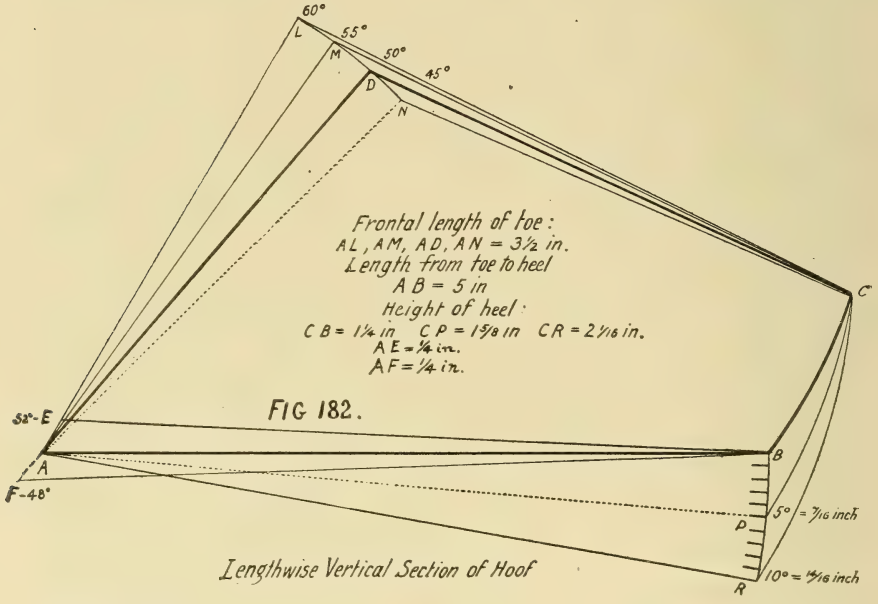
It will hardly be necessary to recall the various instances where the angle and the length of the foot were effective in producing the required extension or its check, but we shall look into other cases nevertheless. From the lengthwise section of the foot, as given in Fig. 182, as well as from a few further illustrations, the reader may gather the importance of the apparently small details connected with the paring and trimming of the hoof. One lick of the rasp more or less can disturb the equilibrium of the foot or direct it as it should point to remedy a faulty motion. All this delicate work is largely dependent on the unquestioned skill of our intelligent farriers, who have made a study of this matter.

It is in their hands, too, that a defective foot can be assisted by a shoe furnishing certain compensations required. I am not as anxious to advise these skilful mechanics as I am to give them indirectly a method whereby they can more readily understand what is wanted of

them. As it is, they are supposed to remedy what the trainer himself cannot often explain to them. They are really overburdened with responsibility.

While, therefore, many of the effects of the angle and the length of the foot were anticipated in the experiments given, the further demonstration of the facts and figures involved will not be amiss in point of argument.

The terms "low toe" and "high toe" used by David Roberge are entirely misleading and erroneous in my opinion, for the toe can in



reality be only *long* or *short* according to the distances along the frontal surface of hoof from coronet to tip or end of hoof. When the toe appears to be either "high" or "low" that difference and the various shades of it lie in the *height* of the heel, for it is the heel that determines the angle of the foot. The same toe may appear *short* with a *high* heel, as the foot L A R in Fig. 182 will indicate, and again, it may appear *long* with a *low* heel, as D A B will show.

The term *"length of toe"* should, therefore, always be used in conjunction with the angle of the foot, or the height of the heel. In the illustration the toe A D is for all positions of the heel a fixed quan-

tity (3½ in.), but we may reverse the order of things and shorten or lengthen the toe at A and retain the same heel at B. For instance, D E B would be an absolute shortening of the toe to 3¼ in., and D F B an absolute lengthening of the toe to 3¾ inches.

When both toe and heel are lengthened we may more appropriately speak of *lengthening the whole foot.* It is very often extremely difficult to understand the meaning of giving a horse "longer toes," whether a longer toe with the same heel is meant as the required change, or whether the toe *and* the heel are to be left longer. In the former case the angle becomes smaller (D F B is a smaller angle than D A B) and in the latter case the angle remains the same and the line of the sole would be parallel to A B from the lengthened point of toe at F to a point below B at heel; in other words, the whole hoof would be lengthened.

Mention is made of these terms because there is some confusion of ideas in regard to these matters. When the shape of the foot can be readily determined by the simple process of measuring the length of toe on the frontal surface of hoof and by determining the angle it makes with the heel, there is really no necessity of any confusion of terms. By taking notes we can always establish both conditions again at any subsequent shoeing; but to tell the shoer that a longer toe is wanted without taking into consideration the angle of the foot—that is, the height of the heel—leaves at all times a vast deal of uncertainty and doubt in the mind of a well-meaning shoer. These two terms, namely, length of toe and angle of foot, should suffice to indicate its shape and by them should all changes be designated. A pair of calipers or compasses and a hoof gauge should be in the possession of every trainer and should certainly form part of the tools of any reliable shoer. However much skill of eye or of hand he may possess there is nowadays a demand for scientific exactness in the execution of details, which also holds true in regard to the shoeing of the trotter and the pacer.

Even with the tools at hand to determine the length of toe and the angle of foot, the *lateral balance,* or the height of the quarters, is a task which must be left to the eye and the skill of the farrier.

Knowing whether a horse points outwardly or inwardly, or whether he travels too closely, or whether his fore or hind feet land at equal distances from the middle or median line, will determine if the center of gravity of the animal moves in the plane dividing the horse lengthwise into two equal halves. If from the results of the lateral measurements there is, as we have seen, a habitual tilting of the body to one side and the feet land at unequal distances from the median line, there is generally something the matter with the lateral balance of the foot. Knowledge of such facts will, therefore, enable the shoer to adjust the lateral balance to remedy the fault, even if such raising or lowering of one side or the other of the foot may not satisfy the eye; for, lateral balance, as well as the whole question of shoeing and trimming the foot, is in most cases one of compensations rather than of ideal conditions.

To have simple and exact terms in describing the conditions of a hoof is of great importance, and instead of calling L A B (Fig. 182) a foot with a "high toe" or otherwise, let us take into account the only two rational conditions possible, namely, that L A B designates a foot with a toe length of 3½ in. and an angle of 60°, or D A B is a foot with a toe length of 3½ in. and an angle of 50°.

If with the heel fixed at B we shorten the toe to the point E, we have an angle D E B of 52°, or if we lengthen the toe to F we have an angle D F B of 48°. Again, if the toe remains at A and we leave the grown heel at P, or apply a shoe to raise it that much, we have an angle D A P of 55°. In all these cases, therefore, we have simply to account for the length of toe and for the angle of its frontal line with the sole to establish the same conditions at any subsequent shoeing. We do not have to guess to get it "about right," but know exactly what it should be from the results of the same conditions prevailing before.

The reader should make himself familiar with the three principles of Roberge regarding the trimming of the foot. On pages 78 to 80 of his book he describes very ably the leveling, the symmetry and the balance of the foot, and gives the good advice "to remove horseshoeing from the domain of empiricism and place it in the region of

science and art where it ought to be." What is empiricism but a set practice based on each man's limited experience, a practice often founded on erroneous suppositions and an experience gathered from inexact observations!

By balance he means "the perfect adjustment of the shoe in the fore and aft direction," and he should have included in that statement the very thing which Fig. 182 illustrates, namely, the toe length and the angle of the foot.

Leveling to the "white line," a proper horizontal surface of sole from side to side and finally the requisite toe and heel—these are the three important principles of paring the foot. On these are based the averages of the measurements given by me, since they form the safest indications of balance, or the lack of it.

It should at all times be remembered that balance is not a fixed quantity, but exists absolutely for a short time only. The growing foot and the wear of the shoe soon make of it a questionable condition more likely to cause disturbances rather than improvements.

It has come under my observation quite frequently that hoofs develop or grow unequally, not only with regard to each other, but also with regard to the growth at the toe and at the heel. It is easy to find this out if the calipers and the hoof gauge are applied to the hoof *immediately after the shoe has been taken off* and the data of its toe length and its angle be compared with the data of the last shoeing, or the exact condition of the foot before the shoe was put on. It is well worth while to make these comparisons, as they enable us to allow for such a difference of growth and to be on the lookout for resulting irregularities of gait.

Reference is here made to the case discussed under Figs. 131, 132 and 133, where the near hind foot showed an angle of 52° while the off hind measured 55°. While the off hind looked like a club foot at first on account of its steep angle, it did not prove to be one. It was simply a case where the work had been done by the eye instead of by the gauge.

Other similar cases where no care had been used came under my

notice and there was an immediate improvement in gait once the cause of the previous uneven motion had been removed.

As to the relative merits of long toes or of high heels, it is a matter often of choice rather than of judgment. This was discussed elsewhere but will bear repetition. I prefer at all times a reasonably short foot and like to have the horse, as it were, close to the ground. Besides defending the merits of such a condition I feel about it as I do about long fingernails on human beings, for one with long nails is not apt to be a person able or willing to take hold of things. Such a person may be good to look at and even intellectual and perhaps also "speedy," but will hardly be able to stand the strain of a hard contest in the race of life.

The toe of the horse, no doubt, has its important function in propulsion, as can be witnessed on the ground, but as for its adding distance to the stride or taking off seconds from the mile, there seems to be an opportunity for the traditional Doubting Thomas to assert himself by a shake of his head. The added strain to the leverage from heel to toe, due to an unusually long toe, will undo the advantage gained as claimed. Of course, we might argue that a long toe with a higher heel lessens the leverage and moreover lengthens the whole leg, and by that means the distance covered in a certain unit of time will be greater and the speed therefore increased; but, again, I doubt if a man on stilts could beat a man running on foot at any fair distance. Besides, the very fact that Nature sheds all superfluous horn of the hoof and danger of disease lurks in long hoofs should be a caution to the adherent of long feet.

The heels have at times a better reason to be high to counteract a strain, for instance, on the fore legs, such as swelled ligaments, or tendons; and it must be left to the trainer to take such temporary or permanent measures to alleviate such conditions.

As is well known, the toes of the fore feet may be a trifle longer than those of the hind, and again, the angle of the fore feet is naturally lower than that of the hind. This is based on the proper separation of the extremities such as is required for a good gait. Very many trotters shove back their fore legs too far and put forward their hind

legs excessively, so that not only interference but also a defective gait is the result. It cannot be expected to fix any definite angle for either fore or hind feet; but as a rule the frontal line of hoof should form a continuation of the direction of the pastern joint. The extreme range might be given as being from 45° to 55° for the fore and from 50° to 60° for the hind feet.

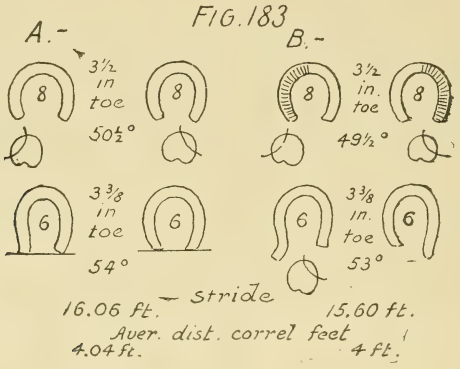
Fig. 182 will give the reader an accurate idea of the sections of the feet with these various angles. If it is considered desirable to retain a certain height of heel, or if it is impossible to reduce the heel, corresponding changes in the toe will bring about the angle of the foot best adapted to the horse.

Lateral balance or "symmetry," as Roberge calls the leveling of the foot from one quarter to the opposite quarter, concerns the direct lines of motion of the feet and my method of analyzing it by means of drawing a while cord midway between the sulky wheels and referring to it every track with regard to its distance from it and the inward or outward angle it makes with reference to this median line, have all been discussed before, but its importance may demand some more attention.

Whenever it seems necessary to lengthen one leg more than the other the toe is lengthened that much, but the angle is kept the same, for in that case the sole line A B will be let down, so to speak, for a certain distance all the way from toe to heel, which makes it parallel to the former sole line A B; but while the angle remains the same the heel is of course raised also, so that with both toe and heel raised we have a longer leg. Moving the line A B down and parallel to its former position will therefore lengthen the whole foot, as it should be when so wanted.

Experiments have proved the rule given heretofore and applicable to most cases, namely, that the longer foot of the two fore feet will act as a lever for the shorter one and will therefore not extend as much as the latter; and, again, that of the two hind feet the longer foot will extend farther than the shorter one. Whether we speak of a longer foot or a longer leg does not matter, the effect being the same; and so it may happen that a shorter extension, or as it is erroneously called

a "shorter stride," may have for its cause these differences of actual length of leg. All this would have to be ascertained by trials and experiments to that effect. As a rule it is far more dangerous to have an inequality in front than behind on account of the stiffness of the front articulation, and this is especially true of the near fore with its choice of extension around the turns, as we have seen before. Here the jar of a longer foot may bring about a sprain of the ligaments and tendons. Behind, with the looser motions of quarters this danger of injury does not obtain so much. If there is such an inequality it is likely to be alleviated by a hop, so often seen in badly gaited horses. A curb or a spavin is, however, likely to appear when the forward extension is either too great as a whole or excessive in one hind leg only, especially when the lateral balance of the foot is also faulty.



Now, let us look at a few more examples to illustrate once more the effect of the various relations between toe length and angle of the foot.

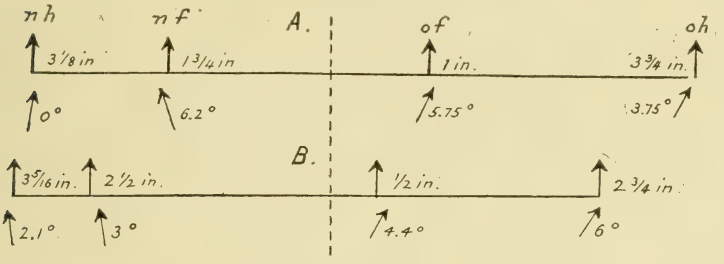
Let us take, for instance, a case where the changes were only in angles of fore and hind, as in Fig. 183. The toes remain the same in length, while the heels, both in front and behind, are lowered one degree in B, as compared with A. The front shoes in B are beveled on outside half to prevent knee-hitting, or toeing out, and the outside heels of hind shoes are longer to induce hind feet to toe out more. We shall see, incidentally, that the fact of outside heels being longer does not cause the feet to spread more apart in this instance. The stride in A is

5½ inches greater than in B, and yet the distance between fore and hind is practically the same in both. We have found, however, that the distance between the extremities generally increases somewhat with the longer stride.

The subject was a two-year-old colt by Zombro 2:11¼, a son of McKinney, and had a good square gait. His fault in front lay in excessive outward angles and consequent brushing of knees, and furthermore a deficient forward extension of hind legs. On that account the front shoes were beveled for an easier break-over outwardly, with the results as given in Fig. 184. The feet were also pared as indicated to conform to the rules of pointing.

The tracks showed concussions of outside heels in both front feet, but more so with the right fore, and behind both heels of the near hind

FIG. 184.
reduced one half.



and outside heel of the off hind left too hard a contact on ground to be favorable to a good gait. There was, however, this difference between A and B: in A the inside heel used to strike the ground first and cause foot to twist or toe inwardly, while in B, with the longer and turned outside heels of both hind shoes, the contact was even with both heels on the near hind and it left no particular heel concussions of the off hind. In reality, the off hind was suitably shod while the forced outward angle (from 0° to 2.1°) of near hind told its story by increased concussions of *both* heels. There was in B a greater forward extension with near hind (1⅛ inch), which may have been caused by the horse trying to avoid a shock. At any rate, the difference was negligible, as the diagonally opposite off fore also extended slightly ahead of the near fore (½ in.) It is not evident, however, that the outside longer

heels of hind causd a greater spreading of hind legs, but they must be held responsible, more or less, for the distance between extremities (B:4 ft.) being about the same as in the previous trial (A:4.04 ft.), in spite of the lower angle (53°), whose effect on extension these heels somewhat nullified. In addition to this the lower angle in front (B) had the effect of extending the fore legs, and this lower angle is itself more effective than the lower angle of hind feet. *The front feet, as a rule, respond more readily to a smaller change in angle than do the hind feet,* which no doubt is due to the greater rigidity of the fore quarter.

It may be well to state here that the variations from the average stride were less in B than they were in A, proving that the gait in the second shoeing was more adapted to the horse. I have always found that if the variations of all four legs were nearly even in extent and small in compass the gait of the animal was fairly regular and square. Merely as a side information these variations show the regularity or irregularity of motion.

As mentioned, this colt had a peculiar lack of forward extension of hind feet and his toes were dug into the ground a good deal. A long toe behind increased such a fault. His backward extension with hind legs was marked, but the lack of elevation, or rather the absence of the power to suspend his toes and thus make the forward reach of the hind count as well, made his backward extension void, and moreover put a severe strain on the muscles of his back and loins. Continuing through all trials with the same adjustment of the fore feet, but putting on a 10 oz. shoe instead of an 8 oz., the various changes behind proved that where such a serious fault of extension exists, due to some weakness in ligaments or tendons or muscles, the easiest adjustment is the best. Great sustained speed, however, cannot be expected in any such case. Our first duty is always to remove the cause of the visible concussions on the ground, for these cannot, in any event, be conducive to either speed or good, easy action.

Longer toes of 3½ inches on both hind increased the distance between the extremities in one instance to 4.76 feet and in another to 4.88 feet, with strides respectively of 16.54 feet and 16.61 feet, the angle being 53° in the first and 52° in the second instance. Shortening

the toes again to 3⅜ inches, or as much as could be taken off, and increasing the weight of hind shoes to 8 oz. and squaring the toes of same, gave better results. The angles were lowered to 52° and even 51°, with slightly swelled heels in shoes. This adjustment tended to increase the hock action and to keep hind feet lifted somewhat more at the toe till the heels struck the ground. There was a closer approach of extremities in one trial with a stride of 15.80 feet, this distance being 3.85 feet, and very nearly alike for both diagonal distances (3.83 feet and 3.87 feet).

While we have seen that a longer toe by itself increases extension, in this case it aggravated the trouble of dubbing it in the ground, due to some weakness of suspension; and it became necessary through a heavier shoe, a shorter foot and a squared toe on shoe, to increase the elevation in order to obviate to some degree the stopping of extension by a digging toe. With no calks on heels of shoes, but a smooth and slightly swelled web, the forward extension was not visibly checked or converted into merely a higher action, but it was allowed to proceed as far forward as possible after the squared and shorter toe had given it enough elevation to overcome the sluggish suspension of the toe. In both the last two trials the variations of the strides of each leg from the average stride were much greater, of course, than when the animal was permitted to indulge in his abnormal backward extension. In fact, in one trial the tracks behind showed two marks of the shoe on ground, as if the first contact was corrected by the second and closely following one. This double impact by the posterior half of foot showed that the horse was incapable of controlling his toe suspension as soon as the foot got near the ground. Since the heel, as a rule, makes the first contact with the ground the weakness which prevents such a contact was therefore a serious set-back to speed and action, but it was overcome to a certain degree in the above described manner.

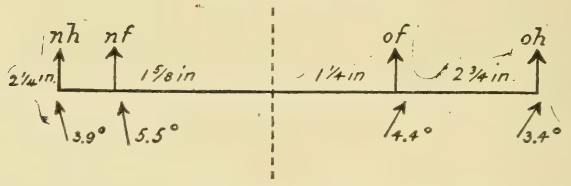
The lateral extensions being at nearly every trial quite satisfactory I present the averages of the trial with the nearest approach of extremities (3.85 feet) in Fig. 185. Being a good trotter it is worth while to note the lines of motion as here given.

The following three shoeings and trials of a colt by Directum,

previously discussed, will further show the effect of shorter and longer toes, or the difference in angle. The subject had been subjected to a few preliminary trials during the fall of the previous year. He was a resolute trotter and had been trained, but had been given up on account of weak hind ankles. When he came under my notice this trouble was not very visible and though he was not trained severely he formed a good subject for an improvement of gait. He hopped a good deal behind in the previous fall, but gradually improved and was a fairly good piece of mechanism, as he went on during the time of these trials, which covered a period of two months.

We start with an even shoeing, as given in Fig. 186. Front shoes are beveled on outside again to guard against knee-hitting. He had too large an outward angle of the fore feet, particularly the off fore (10°) the near fore being less (6°). Behind, the heels had been

FIG. 185.
reduced one half



"eased" so as to avoid any sudden arrest of motion or shock by high or calked heels. The rolling motion shoe on hind, with forward and backward level, was intended to prevent any shock to hind ankles. The effect of these shoes in Figs. 187 and 188 was to increase extension of the hind slightly over that of the fore, this being 0.42 inch in the second trial and about 0.96 inch in the last trial.

In the first trial (Fig. 186) the hind shoes were plain and straight and no such difference of extension between hind and fore existed. Of course, the length of toes had also something to do with this fact. It rarely happens that either extremity exceeds the other in the strides by a fraction of an inch, but when it does occur there is likely to be some faulty extension. In this case we may disregard the weakness of hind ankles and their tendency to forward extension and we may simply consider the influence of the length of toe and the angle, which is our object in view.

The first trial under equal conditions between fore and hind feet produced unsatisfactory results. The subject was not at ease, he hopped and shifted and recovered and the variations of the strides of each leg were great in extent because of this lack of balance.

Retaining the same angles in the second trial (Fig. 187) we lengthen the near fore and the near hind on the supposition that a longer fore

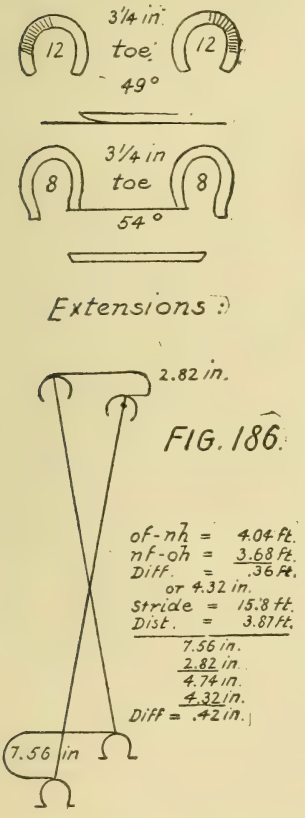


FIG. 186.

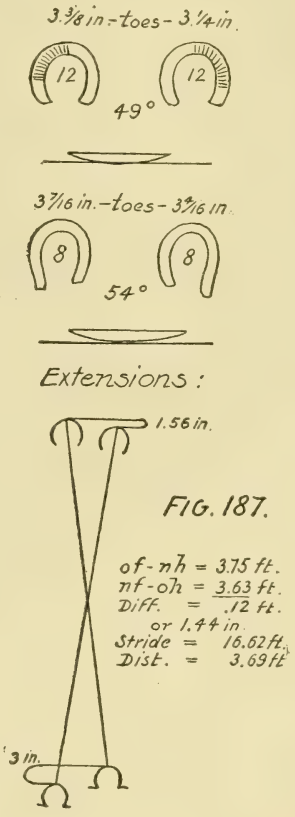


FIG. 187.

foot will stop extension and a longer hind foot will increase it. That is borne out by the resulting extensions of Fig. 187. It is also apparent that by these changes in toe lengths the distance between fore and hind feet has been decreased from 3.87 feet to 3.69 feet, or 2.16 inches, despite the fact of a greater stride (16.62 feet), which generally causes a somewhat greater separation.

By still further increasing the conditions that helped to bring about

the change we now come to the last shoeing of Fig. 188. Here the near fore is stopped still more by a slightly steeper angle and the near hind is modified in its adjustment by a lower angle and a heavier shoe; and the off hind by a difference in toe length of 1/16 inch, this being a little more than in Fig. 187 ($3\frac{4}{16}$:$3\frac{5}{16}$).

The results speak for themselves in the average extensions of the four feet and the distances between the diagonal pairs. Through in-

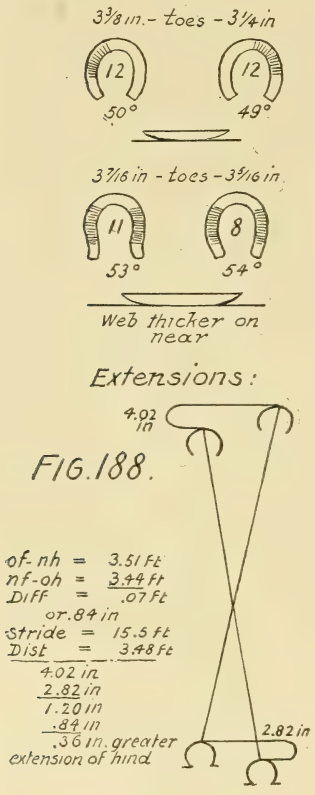
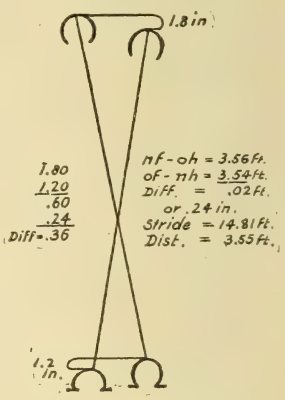


FIG. 188.

FIG. 189.



creased length of off hind, the forward reach of that leg was also increased, while through the greater angle the reach of near fore was also checked, so that we have a greater approach between these two feet (3.44 feet). Again, the increased reach of near hind also reduces the distance between it and the off fore, so that there also we have a closer approach (3.51 feet), giving us a smaller general average distance of only 3.48 feet as compared with 3.69 feet of Fig. 187.

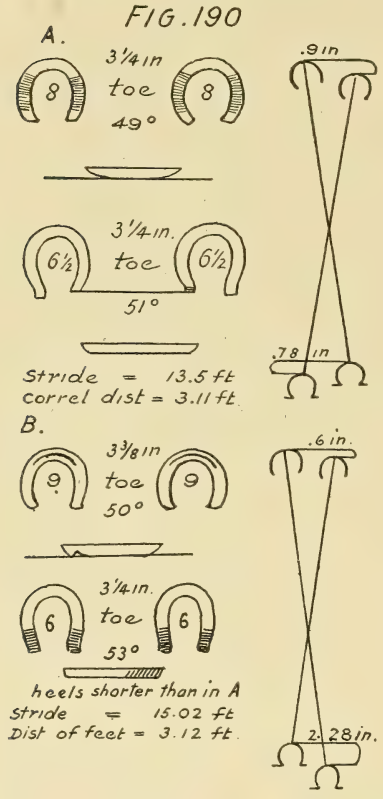
In the last trial we have again an increased stride of the hind over fore by 0.36 inch, due no doubt to the condition of hind ankles, or their habitual forward reach to avoid a shock. As mentioned before, it is quite uncommon to have this occur, and when it reappears it points to some weakness in the subject's mechanism, or to an abnormal attitude, or to a tendency to hop and run with hind legs. Such a difference is, however, only temporary if the animal continues to trot squarely.

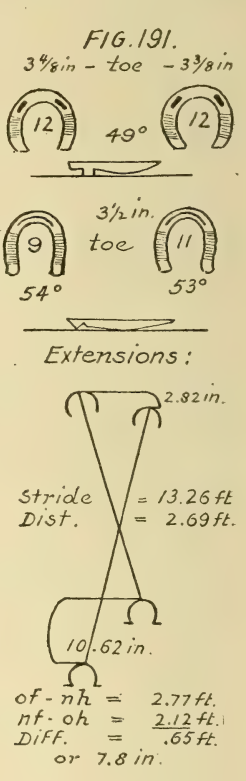
The animal was trotting pretty well and of the three trials that of Fig. 187 seems to have been the one showing the best movements. In it also is found the least extent in the total variations of the individual strides from the general average, while in Fig. 188 these variations are increased slightly, but are not so abnormal as in Fig. 186. Excessive variations mean that the efforts at each stride are forced and labored, due to some inadequate or deficient balancing. Whether as a temporary or permanent adjustment, the inequalities in angles or lengths of toe, or in the shape and weight of shoes, will often correct the natural or acquired defects of locomotion. Forcing the subject when going badly in the hope of training him out of defects is not a method worthy of imitation because of its crudeness and unreasonableness. A proper investigation of such a gait avoids much loss of time and much aggravation.

As before mentioned, most of these experiments were made on a slightly downhill course, and I deem it to be a good test for proper balance to have the animal tried on such an incline. Let us take, for instance, the last trial which was trotted *uphill* by this Directum colt. He moved resolutely and seemed to be going a little better. Fig. 189 will show the extensions. The stride (14.81 feet) was shorter and the distance between the extremities greater (3.55) by 0.84 inch than in trial of Fig. 188 (3.48); and again, the hind legs showed the same slightly greater stride than the fore by 0.36 inch. It will also be seen that the extensions were the reverse of those of Fig. 188 and similar to those of Fig. 187, but more uniform than the latter. All in all, therefore, the two ways of going are worth comparing and may lead at times to suggestions for a change in shoeing. I will not go so far as to advise such double trials in each case, but where a horse proves

to be better gaited uphill than downhill it may help to solve the problem of balance by ascertaining the facts of such a better locomotion. In a later chapter this will become more evident.

A filly by Sidney Dillon may serve as a further illustration of a change in angles and toe-lengths. Fig. 190 will give two consecutive shoeings about a month apart. From equal conditions in A we change in B the toe-lengths in front to 3⅜ inches and the angles from 49° to





50°, and also increase the weight of the shoes. The shape of the front shoes is also slightly altered and a crease at the toe is intended to prevent slipping, such as showed on the ground of the trial of A.

Now, this longer toe and higher heel, together with the greater weight of shoe, checked in every way the forward extension of the fore legs. They acted, as it were, like a pair of stilts. A lower heel by itself might have increased their forward extension. Again, the higher heels

or greater angle behind, together with the swelled heels of shoe, were intended to check the forward extension of the hind and to increase their elevation of action; but the heels of shoes in "B" being much shorter than those in "A", the forward extension of hind was not checked as much as expected, because such shorter heels gave the foot a chance to reach farther before striking the ground. Hence, there appears again a reverse extension behind which was found to be the filly's habitual and faulty extension under Fig. 150-155. We also find, in consequence of these two results, that the average distance between the extremities is about the same in both "A" and "B" (3.11-3.12), while we would expect a greater separation with the longer stride of "B" (15.02) than with the shorter stride of "A" (13.5). The principal cause of this approach of the extremities was the checked extension of the fore, and this also tended toward an increase of hind extension. This case, like many others, proved to me the necessity of finding the faults of the locomotion of a horse in order to get nearer a proper balance. The main purpose of this shoeing was to bring about a more evenly distributed action between the fore and hind legs, and the result in gait, though deficient in the respective extensions, showed the action to be so. The case was discussed under Figs. 150-155 in the previous chapter, and we saw in the last trial there that the heel calks, squared toes and heavier shoes on the hind feet caused the latter to attain a greater elevation and an action more in unison with that of the fore.

The reader is now referred to Fig. 132 in a previous chapter where calks appeared on the web of the front shoes near the heels and also at the heels of the hind shoes. The stride was 14.01 feet and the average distance between the extremities was 3.32 feet. The subsequent shoeing of that subject, just three weeks later, is seen in Fig. 191. Here we have the extension of the fore released from the check of the heel calks, and so likewise the hind, which latter have beveled heels instead of calks. By such a radical change the habit of excessive hind forward extension was readily assumed again by the subject, as the diagram will exemplify. It proves, again, that a gait should be thoroughly looked into before we can have any idea how a proper balance can be accomplished, and also that such an investigation will always enable us

to recognize more clearly and quickly the possible remedy for faulty gaits.

There is in Fig. 191 a decrease in angle of off hind which, with the heavier shoe, is responsible for its extension over that of the near hind. In front we have simply a longer toe on near fore, which, with the *same angle,* checks the extension of that longer foot, but the evidence of that check is lacking because of the excessive extension of the off hind. It is sometimes a little confusing to have an excessive extension of one hind leg influence its correlated fore leg, as in this case. Here we have two hind legs with indifferent action and with that tendency to poke forward just above the ground, and while in the former trial under Fig. 132 the calks on hind shoes prevented too great an extension, the present shoes with beveled heels encourage it. We have now an abnormal approach of fore and hind feet (2.69 feet). The forward reach of the off hind has its origin also more or less in a weak ankle, but, as I said, the extension is so abnormal (10.62 inches) that its influence is felt on the near fore, in spite of that foot being made longer to check it; yet the near fore is comparatively little in advance of the off fore, when we consider the inequality behind.

Mention should here be made of an observation which was already alluded to under Fig. 175, namely, that a shorter toe with a higher heel or greater angle of foot has not, as it would seem, the double restraint on extension, such as each of these conditions effects, but rather has often a decided increase of extension as a result. Reference is made to a case under Figs. 145, 146, 147 and 148, where a squared toe was changed to a round toe to check extension of the foot with the squared toe; and also to Figs. 164 and 166, where erroneously the squared toe and higher angle, together with the longer toe, was the adjustment of the hind foot which had been found to be of greater extension before.

The effect of a higher heel is an increased pointing back or an earlier contact with the ground than a lower heel would have. This is based on the facts as photography has revealed them, namely, that the heel of the foot lands on the ground before the toe. Now, with a shorter toe (or as in Fig. 175, with a squared toe) than the opposite

foot the leverage from heel to toe will not be as great, and hence it may happen that the action will be quicker and more elevated. The greater ease with which such a foot is hurled up may then induce it to reach forward more. Besides, because such a foot has not, by the nature of its shape, the ability to take hold of the ground with the toe as the foot with the longer toe, it follows that the propulsion is left more or less to the foot with longer toe and the lower heel. It is always, therefore, a characteristic of the foot that stays behind its opposite mate to leave a deeper toe impression on the ground than the foot that travels ahead of it.

A case of such a hind propulsion was given under Fig. 176, the off hind having a squared toe and swelled heel shoe and a shorter toe, which was corrected in the shoeing of Fig. 178. The near hind at every foot print left a deep toe mark, showing it to be the foot whose slower leverage from heel to toe compelled it to attend to all the propulsion behind, while the off foot hopped and extended forward excessively. It is, therefore, always advisable to equalize this leverage at toe by studying not only the difference of extension, but also the toe imprints of each foot. If it is necessary to make a difference between the adjustment of two opposite feet it should be effected *first* by the *difference* of the *lengths of toes and angles* of the feet *before* the *difference* in the *shape of the shoe* is considered.

While *all* cases are amenable to certain principles which I have tried to expound, each individual horse has its faults and shortcomings, so that only by a plan of its gait can the proper adjustment be found. The apparent contradictions of the principles involved, which at times may puzzle the investigator, will always have their origin in some grievous and permanent defect in the equine mechanism, and an analysis of a gait should precede any changes in shoeing. After that the first change should always be in the shape of the foot; that is, in its length of toe and height of heel. Too much attention is given to the mere weight of shoes, and while this consideration is well worth taking into account the shape of the foot should precede even the shape of the shoe.

Although I have regretted that my opportunities did not include

very many pacers, there has been enough evidence among the few whose gaits were investigated and changed to make the application of the same general principles as rational as with the gait of the trotter. As far as the shoeing is concerned I can not, therefore, offer any similar examples of the effects of conditions that prevailed in the experiments with the trotters, but in the next chapter the pacing gait will be considered to a limited extent when the bothersome single-footing appears as the connecting link between the two gaits of the standard horse.

Warning has already been given against too many changes *at one time* with the idea of effecting a ready remedy once for all. Many of my experiments were not free from this error, because the impatience of others and the lack of time for development urged me to do so. Balance, however, is a matter of slow evolution, especially where any faults of comformation exist; and if permanently beneficial results are sought time remains the biggest factor of the work.

Although the considerations of this chapter on the length of toe and the height of heel, or rather the angle of the foot, follow those on the motion of the horse and the weight and shape of the shoe, they are given rather as a review of the whole subject in hand. Great stress must be laid on the prime importance of the foot of the horse. The subject has, however, been treated so fully by its originator, David Roberge, that little can be added to its main features.

There is one point of practice which seems to stand forth prominetly in every word of that master of the forge. For, not only was he master at the forge, but he was master on the floor as well, and this bids me voice my own view on the usual way of shoeing, namely, of leaving the most important part of the work—the leveling and adjusting of the hoof—to someone else, commonly known as the floorman. Any good mechanic can turn out a good shoe, but only a good farrier can fit the shoe to the foot and prepare the foot to receive it. One man should do the whole job, or at least superintend it properly, because two men working separately cannot do good work. One unnecessary lick of the rasp will often spoil the nicety of adjustment to effect balance.

The many experiments with unequal conditions, due in part to un-

equal conditions of the gait in question, have, I hope, made this important subject still clearer, and have impressed the reader with the importance of the two prime causes of balance, namely, length of toe and angle of foot. Without careful attention to these two prime factors of balance *at all times,* we are apt to land in a maze of confusion and contradiction. In a measure we might say of the foot and balance as we say of the cents and dollars: "Take care of the shape of the foot and the balance takes care of itself."

CHAPTER VIII.

THE HARMONY IN A GAIT.

I.—The Prime Condition of an Easy and Regular Gait.

No trotter can trot and no pacer can pace well unless the two distances between the feet that move together are practically the same when the feet are set on the ground. Whether one pair moves ahead of the other a reasonable distance is of some, but of less, importance to the regularity of either gait, as long as the correlated feet show no marked difference in their respective separations. We have seen that no two such distances are exactly alike at each stride, for the eagerness of the horse, the urging of the driver and the slight unevenness of the ground, all make the resulting exertions of the animal vary in extent; but we can depend on the average of a number of strides as indicating the tendencies of extension and propulsion. What is true of these distances is likewise true of the individual strides.

Take, for instance, the trial of a McKinney mare, with an average stride of 18.91 ft., and with total variations of individual strides from this average comparatively small, namely:

near - Fore - off		near - Hind - off	
+ 1.98—2.13	+ 1.85—2.00	+ 2.25—2.40	+ 2.21—2.01
Total scope			
4.11	3.85	4.65	4.22

The fore showed from 18.55 ft. to 19.40 ft. and the hind from 18.50 ft. to 19.35 ft. as lowest and highest strides. Now, as to the important equality of the distance between the feet of the two pairs as they land on the ground together, we have:

Distance of correlated feet.

n f - o h	*o f - n h*
3.94 feet	3.97 feet

as the two averages, with smallest and greatest distances, as follows:

3.60, 4.15	3.70, 4.35

The difference between the averages is, therefore, 0.03 feet, or 0.36 inch, a negligible distance, which shows both sides to be regular in extension. It should be mentioned that there was a preference of the off fore to precede the near fore by 0.18 feet, or 2.16 inches, and likewise the near hind (the diagonal mate of off fore) preceded the off hind by 0.15 feet or 1.8 inch, the difference being as found, or 0.36 inch greater for the distance between off fore and near hind.

As far as the overstep is concerned, it would naturally be greater on the side where hind foot has a greater extension and fore foot ahead of it has a lesser extension, as in this case would be the near side. That difference here amounts to nearly 2 inches, which in view of the nearly equal separations of fore and hind feet (3.94 and 3.97) becomes also a negligible quantity.

Regularity of gait is not bound by an exact equality of the distances given and must at all times be allowed some elastic form or spring in its progress. We are not dealing with an automobile with its stiff, metallic component parts of machinery, but with the tissues of a highly organized animal locomotion. Let me, therefore, bring before the reader again the excellent pictures of a few horses in motion of recent date, taken remarkably well by Mr. Ted. Hansom of New York.

Fig. 192 gives the trotter Lord Derby 2:05¾, with his two correlated feet—near fore and off hind—on the ground, ready to make a supreme effort to hurl himself into the air while the other pair of feet are getting ready to extend to their utmost reach. The position is interesting in that it shows the difference between fore and hind motion as discussed in Chapter VI under Fig. 156. The easier unfolding of hock joint and its lower elevation as compared with the greater exertion necessary for the front flexion is well shown here in its beginning.

The next position, a fraction of a second later, is seen in Fig. 193, the California stallion Idolita 2:09¼ being the subject. Here we

have the danger point of interference well marked, the near hind being in close pursuit of the retreating near fore. The animal is in the air, but not at his highest elevation from the ground. A better example of the equal forward and backward swing of the legs could hardly be given from life. While the near fore and off hind show nearly the same distance between them as it was on the ground, the other pair again bring out, by their temporarily greater separation, the composite unfolding and descent of the fore leg and foot, this distance being about one and one-quarter times as great as that between the other two feet; but when they also strike the ground they will be closer together than at present.

Our next glance falls on Kingmond 2:09 in Fig. 194. Though the position of the feet is reversed it is in direct succession to the preceding ones. The off fore is well beyond the point of interference in its upward flight for flexion, while the hock action of its correlated mate or near hind is at its greatest height; and the off hind follows the outstretched near fore in its descent, which looks like an unbending column or prop to support the tremendous impact of the horse with the ground caused by the weight and speed of the subject. It is a good example of the relative immobility of the forequarters and of the fore leg as a straight lever of the whole body for the next hurling forward. It looks as if the off hind would land sooner than the near fore, but if we recall the lines of motion heretofore discussed under Fig. 136 it will become evident how the fore with its more vertical and quicker motion will reach the ground at practically the same moment as the hind will with its more horizontal and slower motion. The fore leg has always the momentum of its descent to accelerate it, while the hind has more of a horizontal momentum of less degree.

The picture of two pacers are also offered in Figs. 195 and 196, as exemplifying the features of that gait. Illustrations for this purpose were hard to get, and though Dan Patch 1:55¼ should grace these pages as an illustrious example, it is to be regretted that no good picture could be procured.

Anaconda 2:01¾ and Morning Star 2:04¾ are, however, sufficiently representative of that lateral mode of locomotion to illustrate

FIG. 192.

LORD DERBY 2:05¾.
By Mambrino King, dam Claribel, by Almont Jr.

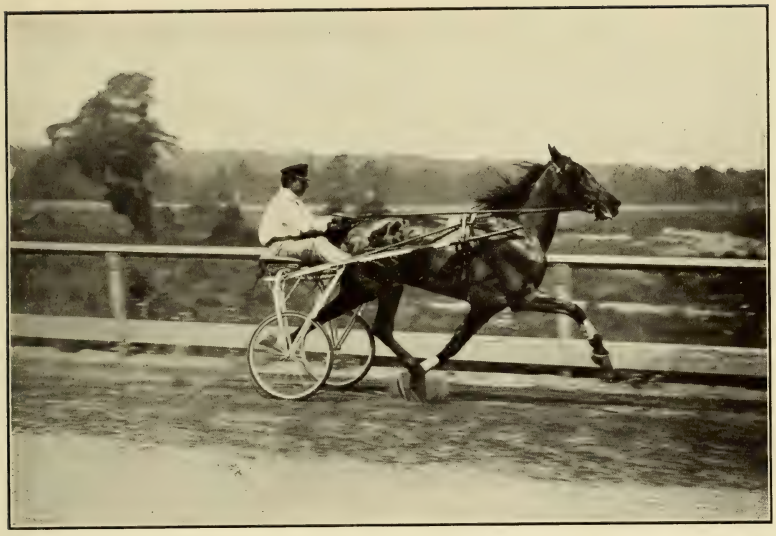
FIG 193

IDOLITA 2:09¼.
By Mendocino, dam Edith, by George Wilkes.

FIG. 94.

KINGMOND 2:09.
By King Darlington, dam Rosamond, by Red Wilkes

Fig. 195.



Anaconda 2:01¾ pacing, 2:09¾ trotting.
By Knight, dam by Algona.

Fig. 196.

Morning Star 2:04¾. (p.)
By Star Pointer, dam Fanny Egthorne, by Egthorne.

a few points in question. Fig. 195 shows the pacer in a position of the pendulum-like swing of the fore and hind legs, as discussed under Figs. 15 and 16. It also brings out well the danger point of "cross-firing," although in the gait of this pacer there was no such interference. We have here also the observation made in Fig. 26 of the gait of a pacer in ten consecutive attitudes. Here as well as there the correlated hind foot leaves the ground a little sooner than its forward mate. That is, in this instance the near hind is well up while the near fore is just above the ground. In the group of the three trotters under Figs. 22, 23 and 24 we notice the opposite movement, namely, the fore leaves the ground a little ahead of its correlated and opposite hind foot, although in Clay, Fig. 25, this is not the case. This seems to be dependent on the forward action, which in the trotter is generally higher and bolder than in the pacer. The easy, low and apparently more frictionless movements of the pacer seem to enable him to use the fore legs more readily as propellers as well as props and levers. In Fig. 195 we see the toe of off hind foot pointing down still, showing that the leg is not stretched out to its full length or ready for the contact with the ground; for, the heel of the foot must be the first to land.

Another instance of the low movements in front as well as behind is shown in Fig. 196, Morning Star 2:04¾ being the object of our gaze just as the animal is in mid-air. The picture is well taken and proves that, although a pacer's movements are lower than a trotter's, the elevation of the horse from the ground is in many cases not any less. While not so fully extended as Anaconda, this subject must have good lines of motion. We can notice, likewise, the equal backward and forward extension on which so much depends for an even fall of the feet and an equal distance between the two pairs of correlated feet.

All of these five horses show a smooth and even action and extension and impress the beholder as being well balanced and one can almost hear the regularity of the fall of their feet. They serve as good living examples of the subject under discussion, namely, that a good square gait must have for its foundation the practical equality of the two distances between the two pairs of correlated feet. The average

distance of one pair must not differ materially from the average distance of the other pair.

This regularity of motion, due to the equal distance between the two pairs of correlated feet, is readily seen when the camera arrests its continuity; but since we cannot always bring into use this marvelous invention and since the eye cannot follow the motion with any accuracy, we must call to our assistance our sense of hearing. The ear will easily detect a lack of rhythm in the uniform fall of the feet and their concussion with the ground. Long before such an event, however, the gait may have been in disorder through this inequality of the correlated distances, but when the ear is offended it is time that we look into the matter as in the next chapter.

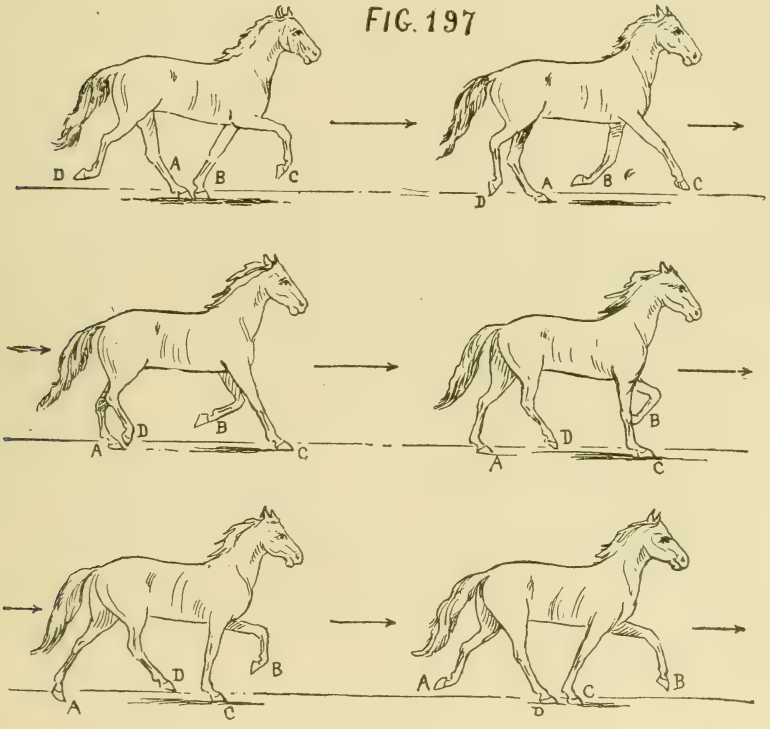
II.—Single-Footing—An Alarm of a Disordered Balance

The peculiar consecutive fall of the four feet, so pleasing to the ear of the rider, but so extremely irritating to a driver, and known very properly as "single-footing," is often the result of a pacing tendency in the trotter, but more often the outcome of a bad adjustment of foot and shoe. I am always opposed to the forcing methods, by which is meant the continued training and driving in the face of such an indication of a bad balance. In the beginning an appeal was made for sane and sensible principles in the development of the standard horse. Many trainers do not recognize the first symptoms of this mixed gait and go on training all the harder to eradicate it. Single-footing, like hopping or any interference or any concussion or sliding on the ground—in fact, any indication that the locomotion of the horse is impeded in any manner by some fault of the horse or by some error of his lord and master—should at once arrest all further development until a clear idea of the commotion or disturbance can be had.

The single-foot as it appears now and then in the trotter and pacer is not the genuine article, but is a sufficient approach to it to cause extreme annoyance. The real single-foot appears in Fig. 197, the positions being taken from the book that originated from the photographic experiments at the once famous Palo Alto Farm. This gait may be de-

scribed as being midway between trotting and pacing, for it may be said that the front legs trot while the hind ones pace. There is a good but rather vertical front action, while behind the action is not only low but more forward. In its purity the single-foot is a delightful saddle gait, but in its adulterated form, mixed more or less with the trotting or pacing gait, it is an abominable hybrid motion. It seems to originate from the same causes such as bring about a high vertical action in front

FIG. 197



and a low and forward action behind. Roughly stated it is caused by a high angle of front feet combined with a low angle behind, but weight and shape of shoe, as well as length of toe, are contributory to its development.

Let us examine the six positions of a single-footing horse in Fig. 197, taken originally from life and then re-drawn. On account of the low and forward action of the hind feet we may say that they come in contact with the ground before the front feet do. In the first po-

sition hind foot A has reached the ground before fore foot B has been removed and before the off fore C has made a contact with the soil. In the third position, C has just come to the ground. Note the distance between A and C and the difference of inclination of the legs due to their *independent actions*. While D and B are off the ground in the second position note the difference in elevation, which seems highest in the fifth position. Directly after that D lands on ground, while its diagonally opposite mate B is about to descend, as in the last position.

The pictures are meant to illustrate the difference in elevation and action between fore and hind feet and to show that such a difference

FIG. 198

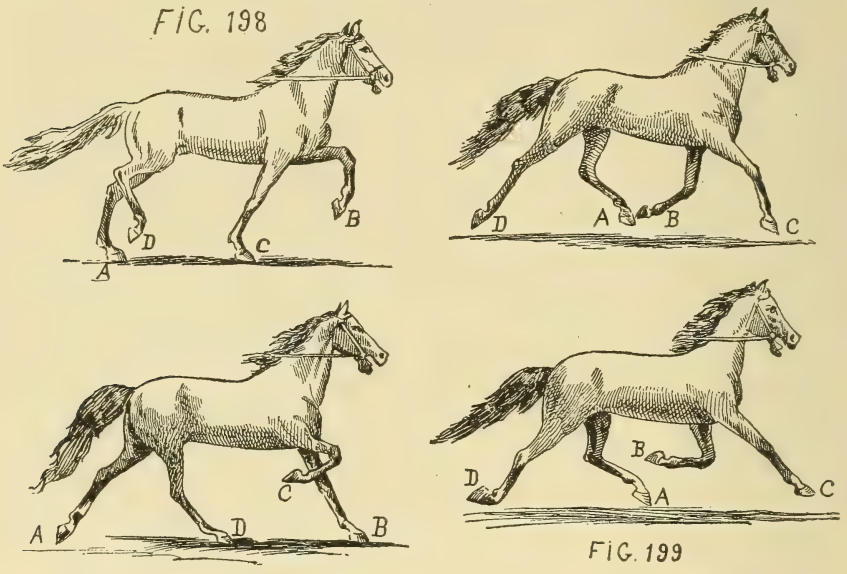


FIG. 199

may at any time, through faulty balancing, bring about in a more or less aggravated form what is known as single-footing. There is among all the feet no connection in pairs, as in the trot or pace, such as have been termed the correlated feet, and each one lands more or less independently on the ground. As before mentioned, the characteristic of this motion is the difference in action and elevation between fore and hind extremities. To make it clearer, a comparison with the attitudes of the flying trot are given in Figs. 198 and 199. The distinctly direct and equalized motion of both fore and hind extremities, as compared with

the positions of Fig. 197, become immediately apparent to the observer. The drawings were orginally made from photographs, as the open mouth of the animal will indicate. In Fig. 199 we see A meeting B, but the latter is not found on the ground but well up, because the motion of B is not independent of the other feet, but intimately related or correlated to that of the diagonally opposite hind foot D. With the horse fully in the air there is visible in each of these positions the equal closing and opening between the fore and the hind on each side. The hind foot A passes under the fore foot B on the same side, as has been discussed before.

Again, in the second position of Fig. 199 the hind foot A, though lower in elevation than its correlated fore foot C, is not quite extended, so that while the fore foot C is descending the hind foot has still time to straighten out and strike the ground heel first. This shows that there is a harmonious action between the two feet that travel together, for these must strike the ground at the same time. The time-beat of the trot and the pace should be: one, two—one, two; while the time-beat of the single-foot, or any of its imperfect variations, is: one, two, three, four. And again, to make either the trot or the pace quite regular the two time-beats must not be like those of a limping pendulum, with the accent on the "one" or the "two."

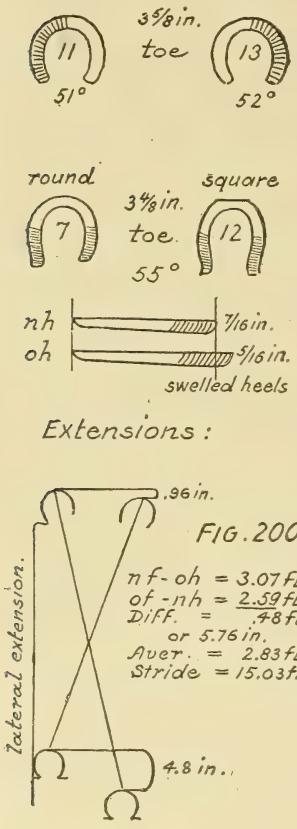
Assuming that the two horses given in Fig. 198 were one and the same animal, we should, therefore, have the distance A C = D B, or at least the averages of each for a number of strides should be alike or very nearly so.

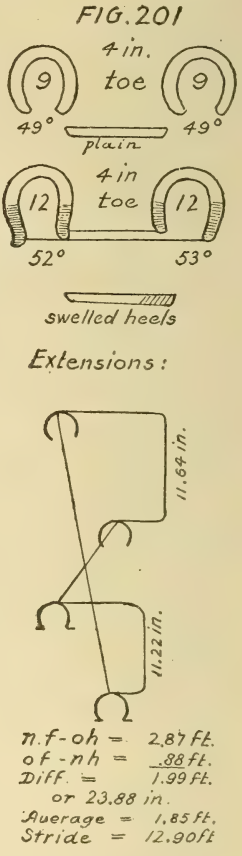
Let me bring before the reader two cases of trotters showing the ambling gait due to faulty or inadequate shoeing. As a preliminary remark, and one that is borne out by many observations, I may state that where excessive extension is found to be either with one leg only or with the pair of hind and fore feet that do *not* move together—diagonally in the pacer and laterally in the trotter—there is evidence of a mixed gait, or lack of proper balance.

The first case (Fig. 200), is that of Figs. 137 to 140 and 142 of Chapter VI, where an excessive extension of the near hind was caused by the inactivity of the off hind. Similar conditions exist in an inter-

mediate but faulty shoeing, which caused the horse to amble or single-foot to a slight extent. In fact, my notes tell of a *"peculiar feature of the trial being his inability to trot squarely and his reaching the ground too soon with hind feet, which caused ambling or single-footing."*

Compared with the trials under Figs. 137-140 the average distance between hind and fore feet in this case (2.83 feet) is far below those





former trials, which is no doubt due to the longer heels and squared toe of the off hind, as well as to heavier shoe and greater angle of the off fore. The near hind still retains the habit of excessive extension. The notes on measurements of extensions from median line give a very *marked contact with ground* of the heels of the off fore and the off hind. There seems to have been a premature contact with

near hind due to greater swell in heels, which in turn brought down the off fore a second later with its heels striking hard on ground. Then followed the off hind with its combination of squared toe and longer heels, which again preceded its correlated near fore in striking the ground. The forward reach of the off hind is seen in the marked contact of its heels with ground. Altogether there were, therefore, the four consecutive time-beats of the amble or single-foot. However faulty the shoeing may have been, such conditions may exist in the shape of the foot, naturally or through careless trimming. It only goes to show how a fault in the gait may be further accentuated or increased by a wrong adjustment.

A still more aggravated case was that of a good big trotting mare by Steinway, whose attitude in front as well as behind was faulty, in that she pointed back with fore and forward with hind. She could trot a mile in better time than 2:25. She was shod heavier behind for a trial, but in error, it must be admitted, as the results will show. In Fig. 201 that shoeing is given. Under "Toeweights" she appears in Figs. 121 and 125. The shoeing now given shows a trial with heavy hind shoes with smooth heels, the *near one having longer heels.* The mare's habit of forward pointing with the hind feet was simply aggravated thereby and the result was that peculiar extension of the feet, as given.

The gait started with a trot and ended in a sort of a single-foot, which was all due to the greater and easier extension of hind feet. This single-foot had the characteristics of the pure single-foot, as illustrated in Fig. 197, but it resembled the pace as well by having the greater extensions on the near side only. If urged still more the mare would have broken into a run to regain her balance. Of the 20 strides shown 12 were trotted and 8 single-footed. The averages of the 12 trotting strides were as follows:

near — Fore	— off	near — Hind	— off
12.98	12.92	13.05	12.98

showing even then an increased extension of hind over fore of 0.06 feet or 0.72 inch; that is to say, the average stride of the fore is

$\frac{12.98+12.92}{2}$ = 12.95 ft., and of the hind $\frac{13.05+12.98}{2}$ = 13.01 ft. The general average for that part of the performance is 12.98 ft.

With the thirteenth stride begins the mixed gait, the fore action being short and high and the hind action long and low. In fact, the single-footing had the effect of decreasing the general average stride of the whole trial to 12.90 feet approximately.

Now, for the last eight strides we have the following averages of the fore legs:

near — Fore — off		near — Hind — off	
12.71	12.55	13.07	12.85

showing an average for the two fore of 12.63 ft. ($\frac{12.71+12.55}{2}$) and for the two hind of 12.96 ft. ($\frac{13.07+12.85}{2}$), the general average of the fore and hind being approximately 12.80 ft. ($\frac{51.18}{4}$), so that we have a shorter average stride with lessened forward extension and increased hind extension. Here we have a difference of extension of hind over fore of 0.33 feet, or 3.96 inches.

Averaging these two differences (0.06 feet for 12 strides, and 0.33 feet for 8 strides), we get about 0.17 feet as the average difference of extension of the two hind over the two fore, or 0.085 ft. as the actual difference in extension between the front and hind extremities. This same difference is visible in the calculations of the distances of opposite feet and of the diagonal or correlated feet. In the former we have the totals as follows:

Averages.

Fore.		Hind.	
o to n	n to o	o to	n to o
7.35	5.41	7.40	5.53
+1.94		+1.87	

as shown in the extension of Fig. 201; that is, one-half of such differences constitutes the actual difference of extension of one foot over

the other. In other words, in this case the near fore exceeds the off fore by 0.97 ft., or 11.64 inches, and the actual difference of extension behind is 0.935 ft., or it is 11.22 inches greater for the near hind. This makes the separation between the correlated or diagonally opposite feet equal to the sum total of these two differences, or 22.86 inches, whereas ordinarily the difference should be only nominal.

Now again, we have by the crosswise differences in the measurements of the near fore and off hind and again of the off fore and near hind the following two averages of the totals:

Dist. correlated feet.

n f - o h	o f - n h
2.87	0.88
+1.99	

showing an actual difference of 1.99 ft., or 23.88 inches. Under ordinary circumstances this should equal $\frac{1.94 + 1.87}{2}$, or 1.905, as the difference between opposite feet indicated above. The two calculations should tally and are always a check on the correctness of the figures. But here we have a difference of 0.085 ft. (1.99 — 1.905), which is one-half of the difference of the two extensions of the hind over the fore, namely, 0.17 ft., as given above. This difference in extension appears also in the sums total of the fore and of the hind extensions, as given in the average distances between the opposite feet, namely:

$$7.35 + 5.41 = 12.76 \text{ for the fore, and}$$
$$7.40 + 5.53 = 12.93 \text{ for the hind extensions,}$$

giving us a difference of 0.17 ft. between the two hind and the two fore; that is to say, $\frac{12.93 - 12.76}{2}$ will again express the actual difference in extension between fore and hind extensions. This difference of 0.085 is also found if we take the difference between the distance of the correlated feet and that of the opposite feet as found in inches, namely, 23.88 — 22.86, which is 1.02 inch, or 0.085 ft.

If there is any difference of extension between the fore and the hind it will generally appear in the averages of the fore and of the hind, when the averages of the distances of one foot to the opposite one

are taken. For practical purposes this is the most important and the

FIG. 202.

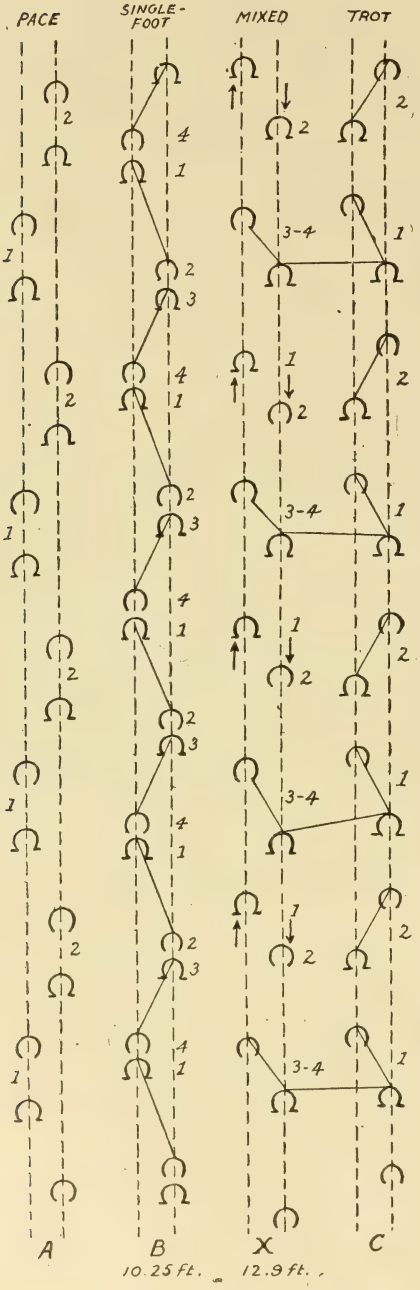
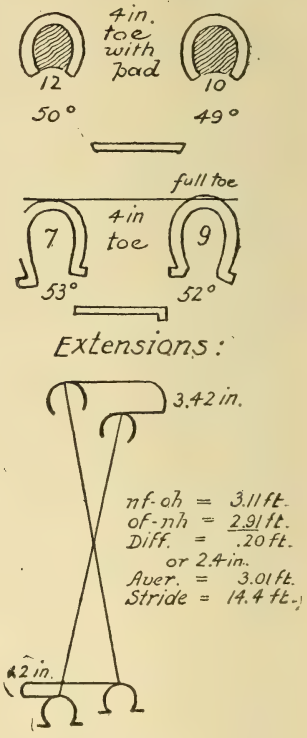


FIG. 203.



easiest calculation to make and will reveal the average position of the feet without much trouble; but to establish a more complete picture of the locomotion the various other averages are resorted to as a check on the first figures.

This matter is entered into so minutely in order to show that even in a case like this one, where it is difficult to get at the various differences in measurements, there is a demonstration possible, not only of the extensions, but also of the lack of harmony between the figures, for such harmony is ordinarily found when the locomotion is a pure trot or a true pace.

All these details of the relative positions of the feet may strike the reader as too fine or hair-splitting, and they are merely given as a demonstration of the reliability of the measurements and their averages. The fact is at least established that the hind extension is not in accord with that in front, and that from a good regular start the gait degenerates into a half single-foot at the twelfth stride, and continues to get worse by the twentieth stride until finally it would end in a break or run. This gait was, therefore, while it lasted, a cross between the real single-foot and the trot. A glance at the table of Fig. 202 will illustrate this still further. Here we have the tracks of the single-foot, as shown in Fig. 197, in the lines of motion marked B. The time-beats are distinctly and evenly divided into 1, 2, 3, 4, and the feet land as numbered. The tracks resemble in position those of the true pace, A, where fore and hind on *either side* move and land together with equal distances between them to the time-beats, 1, 2.

In C we have the tracks of the pure trot, where the *diagonally opposite* feet move together with equal distances between them, and where the time-beats are also 1, 2.

In X, finally, we have the tracks of our present subject, half trotting and half pacing, or rather engaged in an imitation single-foot. While the feet marked 3-4 move together as in the trot, but do not quite coincide in the contact with ground, the feet marked 1 and 2 show a reverse extension from a similar pair of feet in C. The little arrows indicate the pointing back of off fore and the pointing forward of near hind, a position clearly indicated in the average extensions of

Fig. 201. The near fore and the off hind retain their positions almost as in the trot C and are connected with these by lines to show that fact. Again, as to the time-beats we have a mixture of the regular 1, 2, 3, 4 of the single-foot and the even 1, 2 of the trot, for in X we find the 1 and 2 fairly evenly divided, while the 3 and 4 follow closely together, as the dash between the figures is meant to indicate. The alignment of these four gaits by the positions of the feet and their time-beats, as represented in Fig. 202, will serve as a study in comparative locomotion.

To correct the shoeing of Fig. 201, which produced the mixed gait, the next trial was made with the shoeing of Fig. 203, where the principles of unequal angles and weights were supposed to adjust matters again to their normal conditions. The extensions as given, and the whole gait for that matter, proved that the mare was moving fairly well. She was at least free from any trace of single-footing. The near fore still retains the habitual extension, due no doubt to fear of interference on that side, but behind the change is remarkable. The calks in hind shoes have a material influence on the separation of the fore and hind feet, for, in this trial, the average is 3.01 ft. against 1.85 ft. in the previous one, while the stride also is more free and extended.

All in all, therefore, the correction brought about a definite improvement. The heels of both hind shoes are alike; that is to say, the heels of the near hind are not ¼ in. longer as they were in the previous shoeing. This had undoubtedly a great deal to do with her irregular gait, but the greater hind extension was principally due to the heavier *hind shoes* with *smooth heels*. This is especially true of horses that point under as this mare did. The check to such pointing seems to be calked heels and these modify not only the extension, but also change the inclination to reach forward to one of higher action.

Whenever such a mixed gait occurs an immediate recourse to these measurements and their averages will locate the fault without fail and will at least enable the trainer to understand the trouble. We may at times be in error regarding a shoeing and a mixed gait may be our reward, but after an investigation of this sort — which takes much

less time than it did to write this chapter — we may at least apply such remedies as suggest themselves. Subsequent investigations will then reveal the fact whether the work was done on correct lines, or whether further changes are necessary to wipe out all traces of a gait such as the single-foot.

CHAPTER IX

DOWNHILL AND UPHILL TRIALS COMPARED.

Slight grades prevail on almost every track and many experiments enumerated in this book, and many more not given but corroborative of the facts explained, have all been taken with such conditions known. About twenty-seven of these were trials in both directions consecutively over the same ground. Various horses were used as subjects and the comparisons between uphill and downhill will perhaps serve as indications of the effect of such grades under the same adjustment of shoes. Some horses preferred to go uphill, that is, their movements were better and such improvement of gait gave rise to a change of the shoeing.

In many experiments preference was given to trials on a downhill grade because it appeared to be a more severe test for the balance of the animal to have the increasing momentum of the body added to the ordinary efforts of locomotion. More weight is thrown on the fore part of the body in the downhill movement, while uphill the weight shifts more towards the hind part of the body.

Reference is here made to Fig. 29, where Abe Edgington is shown under the saddle and where the weight of the rider incites the horse to greater hind action and backward extension. The downgrade movement requires a better control of the motion and a defect in the gait is more readily detected, while the upgrade movement is characterized by an effort to lift the body higher off the ground at every stride and therefore it develops more action. Downhill the horse is hurled forward and downward at every step and his action, while freer, will be lower; but to be exact it should be stated that in going downhill the front action will be somewhat more developed

than the hind action, and, vice versa, going uphill the hind action is apt to increase. Experience of trainers will probably bear out the assertion that the dead-level track is more tiresome for the horse than slight inclines both ways. Mountain teamsters do not as a rule fancy a scientifically even uphill grade for a load, but prefer level stretches or slight downgrades at intervals on a long uphill pull. The let-up in the continuous strain uphill readjusts the muscular system and grants a temporary relief to the horse. This should hold true of the horse at speed, where quickness of motion and the pulling of ever so slight a load use up more vitality than the process of slow but heavy draft.

Again, it is advisable to examine the manner of gait when we take into consideration the benefits of the up and down grades. A long-gaited horse has the advantage over a short-gaited one going downhill, but a short-gaited horse is more effective in propulsion going uphill and does it more easily. Going uphill, be it ever so slight an incline, requires continual lifting and a rapid succession of steps will accomplish that more readily than the swing of a long stride. The downhill incline lends itself more easily to the horse with a long reach because the momentum of his body increases his speed without perceptibly increasing the rapidity of the movements.

A short-gaited horse, however, finds himself in a peculiar predicament going downhill, when his weight hurls him farther than his ordinary stride will almost warrant, and it may happen to him that a break will be his final relief. The long-gaited horse, on the other hand, prefers to take a hill in a gallop because his manner of going is checked by an uphill grade.

The conduct of the animal, therefore, in going uphill or downhill depends on the ability of either modifying or expanding the curves of motion discussed under Figs. 19, 20 and 21. One of the hardest problems of training or shoeing is, in fact, the regulation of the gait so that a rapid motion may assume a little more extension and a long motion a little more repression.

The natural gait of each horse is amenable to but a slight change either way, but the effort to modify either the rapid or the long loco-

motion is worth making if the horse is at all worth training. Every horse should be able to meet the demands of a down or an up grade while he is speeding along at his best. In the hilly section of France called Perche they used to have a course mapped out for horses old enough to be tested for their capacity of *draft at speed.* They were trotted at top speed over several miles of road up and down hill. Time was a factor in this test, so that their strength, courage, endurance and action were under a severe strain during the entire course.

While it is to be regretted that our standard bred horse is not subjected more to the test of weight pulling and thereby would become also a more useful horse by heredity, the great speed attained to-day does in a way constitute a test of strength, endurance, courage and action. Such speed should not be confined to a lone mile on a dead level track, but should be able to surmount the clatter of the hoofs of opponents and the uphill and downhill grades as they may appear on the track. Hence my plan to test a shoeing not only one way of going, but also the opposite way, and to speed the reverse way of the track as well, in order that the test for the balancing may be reliable.

Rather than take the extreme and unreasonable view that a real trotter will trot under *any* conditions and with *any* kind of shoes, it would be far nearer the real truth to hold that a trotter or a pacer will stick to his gait when a proper balance has been established, no matter whether the course is uphill or downhill; for such grades cannot always be avoided and are, moreover, an advantage. But to claim that one of such conditions might at any time be a carelessly prepared or extremely rough track, which lessens speed and endangers racing, is tantamount to giving harness racing a hard blow, against which respectable men should at all times protect it. The aim should not exactly be to prepare for a lone mile under ideal conditions, but to prepare to meet the excitement and turns and twists of a real race with the noise and dust of the contest to boot. In other words, it seems best and more rational to lay the foundations for balancing on extremely broad lines and to be extremely critical as to what constitutes proper balance for each individual horse.

We have here to consider the comparative effects of uphill and

downhill trials on the extensions and the variations of the four moving legs.

An increase in speed, or what amounts to the same thing, an increase in stride, generally causes the extremities to separate slightly more. I am speaking here of animals with normal or fairly regular attitudes, and of trials made with the same or nearly the same adjustment of shoes. For, by means of very different shoeing we do not always observe this to be the case.

Uphill this increase of separation is principally produced by the greater backward and upward action of the hind legs, while downhill such a greater separation is due more to the greater forward action of the forelegs. These observations do not apply to horses with very faulty attitudes, such as standing under both in front and behind, or having either extremity pointing that way. Any increase of speed in their cases seems to affect such pointing still more, since the effort seems to be then to shove back farther with the fore and to reach forward still more with the hind. This applies to all trials made under the same conditions, but with varying speed or stride.

Toe-weights seem to be a handicap to extension on an uphill grade, while downhill they increase the extension. Heavy hind shoes show the effect of higher action better on an uphill grade and the same is true of squared hind toes.

The case of Figs. 183 and 184 illustrates the benefit of squared hind toes when trotting uphill with an average distance of the correlated feet of 3.98 ft., and going downhill the same distance being 4.38 ft. This trotter was peculiar in that he lacked forward extension and action behind and he dubbed his hind toes, thereby causing an abnormal separation of the extremities. The uphill trial gave the smallest distance (3.98 ft.) of any trial. On the uphill grade his hind heels did not have as long a contact with the ground and the ease with which the squared toe yielded to the leverage at toe produced this greater hind action, and in this case also a somewhat better forward extension in consequence. In this uphill trial the fore legs showed great variations from the average stride since the forward action was impeded by a low angle of the foot.

A steeper angle of the feet gives the animal a chance to lean forward and overcome the force of gravity better on an uphill grade. Lower angles lend themselves better to a downhill grade, because the leverage at the toe is somewhat easier, which is due to the fact that the position of the toe is slightly lower than that of the heel; besides, the momentum of the body is aided by the force of gravity rather than impeded by it, as in the uphill grade.

Fig. 204 will give an illustration of the effect of the up and down grade on the toe leverage. On the incline A B of 1, two feet are moving down and two feet up, the former being of a lower angle than the

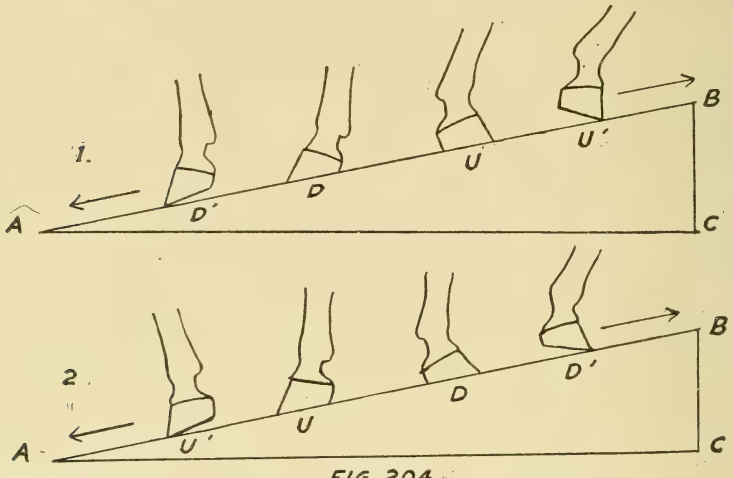


FIG. 204
Extreme angles of the foot on an incline

latter. It will appear that the positions D and D' with their low angles are better adapted for both a reasonable contact with ground and a fairly easy leverage at toe on the down grade, while the positions U and U' going uphill with a greater angle or higher heel show again the better facility for a contact with the ground that will not hasten the breakover at toe and yet will quicken its leverage.

If we reverse the positions of the feet, as downhill in 2 of Fig. 204, we have the higher heeled foot at U breaking over too suddenly at U' and again at D we have the low heeled foot breakover too soon at D' going uphill. The result in the last positions will be the reverse of those of 1. That is to say, the contact with the ground will be

lessened in both up and down grade movements, and the leverage at the toes will be ineffective though easy at U', and also difficult because it does not occur at the right moment, and the consequence of such effects is 1) that the feet U and U' point back and increase the upward action of the leg because of this too quick toe leverage; and 2) that the feet D and D' will point forward to ease the leverage and therefore will lose the effect of a good hold with the toe, because they lack backward extension and action. Or, again, we may say that while U and U' are checked by a higher heel on the down grade the feet at D and D' are checked by the lower heel and the more pointed toe. We shall find on the ground surface a consequent greater concussion of the heels of the former and the toes of the latter feet.

The feet best adapted to the down grade would be D and D' of 1 as the fore feet and U and U' of 2 as the hind feet, while for upgrade U and U' of 1 would serve best as the hind feet and nearly as well for the fore feet. It will be readily seen that if we put D and D' in either figure as the hind and U and U' as the fore feet we shall have as a result a probable intereference and a cramped locomotion, because these legs or feet would in either case point toward each other instead of pointing away from each other.

The practical benefit, therefore, which such trials on inclines seem to offer is a hint as to the angles of the fore and of the hind feet rather than the length of the toes, for the angle determines the ease or the difficulty with which the leverage at the toe takes place. Incidentally it may also lead to the solution of the weight and the shape of the shoes. Attention has been called to the variations which the fore or hind legs may show from the average stride. They may be greater or smaller at either extremity. The horse may "recover" in front, or may hop or change behind, owing to such defective or excessive leverage at the toe.

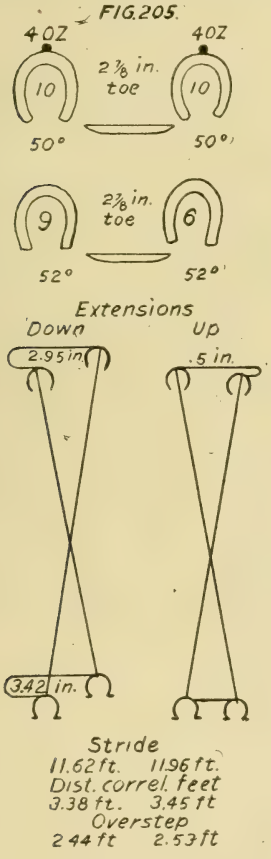
If we take U and U' in 2 of Fig. 204 as the fore feet we shall have excessive ease of leverage; that is to say, the leg may lack forward extension, which would not be the case with D and D' in 1 as the fore feet. And vice versa, in going uphill we would have the feet U and U' of 1 to better advantage than they are in D and D' of

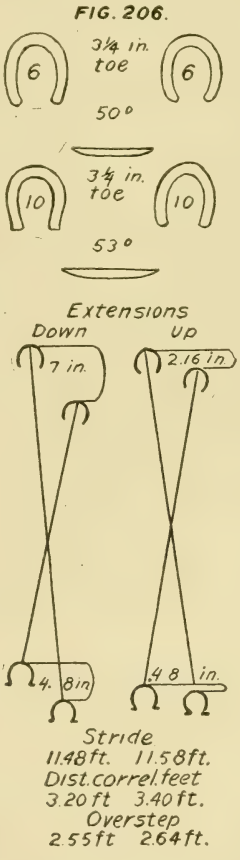
2. Again considering the hind feet, we have U and U' of 2 in a far better condition for the necessary backward extension downhill than they would appear to be as D and D' of 1; but in going uphill the hind feet D and D' of 2 would not be benefited as much by a low angle as they would be in U and U' of 2 because of the lack of heel support and of the difficult leverage at toe. To avoid, however, too great a backward extension of such hind feet, as in U and U' of 1, the angle necessary for an effective leverage at toe, and the latter's hold on the ground, would probably be midway between the two angles here shown. The purpose of pointing out these conditions on the incline is merely to find a remedy for excessive variations in the strides when they do occur in either direction. To insure a regular gait such variations should be but small, and while they exist at all times to some extent, they are attributable more to the condition of the ground and the ambition of the animal rather than to the faulty leverage at the toes.

A few cases as illustration may perhaps serve to bring these points more vividly before the mind of the reader. Let me take the most palpable cases where some pacing inclination existed. These were, one a filly discussed under Fig. 190, and the other one an unsatisfactory little trotter that would pace now and then, but was possessed of no speed. The latter puzzled me a good deal on account of her lack of extension of either fore or hind. There was no action either by which to influence the gait through weight of shoe or angles of feet. She generally showed an excess of extension on one side only, instead of having it appear diagonally across. Heavy front shoes with toe-weights would steady her and give her a longer stride, but at all times she would trot better uphill than downhill. It was always evident that the action was better going uphill, that is, it was equalized more between fore and hind legs. Due to some weakness in hind ankles the near hind would generally extend ahead of the off hind quite a little bit. This filly was by Welcome 2:10½, a son of Arthur Wilkes.

A trial with the shoeing of Fig. 205 resulted in the extensions as given for uphill and downhill. Here again we see the sidelong extensions in the downhill drive. Of course, there was always the disadvantage in her shoeing of having to provide for a smooth hind shoe with a little

roll to it to protect the ankles against shocks. Similar trials with two other cases, where there was a tendency to knuckle over with hind ankles, proved that the uphill trial was done in a better gait, because the ankles did not have to bear the strain that the downhill movements will produce. Such cases form no reasonable basis for any deductions regarding the adjustment of shoes, but they show at





least the effect of the grade; and this may lead perhaps to some suggestion by which the weakness may be supported.

A high heel on the hind feet on this filly, for instance, had a bad effect on her gait, especially when going downhill. In Fig. 205 we have 52° for hind heels, but at a trial with 54° and a few other changes, she paced and single-footed. But again, in a trial of Fig.

206 with heavy hind shoes we find an energetic gait uphill but a rather distorted trot downhill, although she did not show it much to the eye.

The average distance of the correlated feet, and the oversteps of hind over fore especially, showed the greater extension of the hind feet in this last trial as compared with the previous one, for in Fig. 205 we have an overstep of only 2.53 ft. for the uphill stride of 11.96 ft., while in Fig. 206 we have an overstep of 2.64 ft. for an uphill stride of only 11.58 ft.

The longer the stride the greater the overstep applies to any variation of speed for one particular shoeing and also the distance between the extremities increases slightly at the same time. In the former trial we have the toe-weights as agents of greater forward extension, although in the uphill trial this greater extension does not obtain. The fact of the near hind shoe being heavier is due to her habitual greater extension with the off hind, but the effect was not convincing because of her lack of action. These toe-weights are offset somewhat, as far as the greater distance between fore and hind is concerned, by the lower angle (52°) of the hind feet. For, in the second trial (Fig. 206) we have no toe-weights but also a higher angle behind (53°), which we may consider as not materially changing the distance between extremities from that of the previous trial. And still, the greater stride (11.96) causes but a difference of 0.05 (3.45 — 3.40) in the separation of hind and fore as compared with that of the shorter stride (11.58).

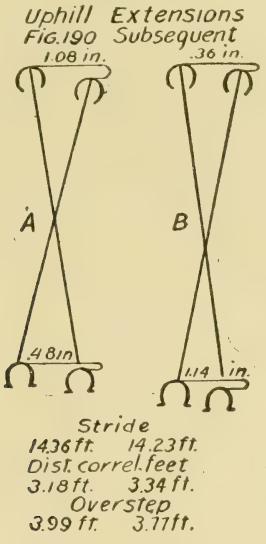
Therefore, the greater overstep in second trial must be due to the somewhat greater extension caused by heavier hind shoes and by lesser extension of the fore due to lighter shoes. This greater extension of hind is still better seen in the comparative downhill drives where the strides do not differ very much in length, and yet both the greater overstep and the smaller separation of extremities occur in the second trial with heavy hind shoes.

All in all, this mixed-gaited and unsatisfactory filly proved by her gait that any uphill drive brought out all the best that was in her. The reason for this was apparently her lack of action behind, which was improved by an uphill movement, and the fact that she had

weak hind ankles, which were helped by the backward incline of the ground; and her consequent position enabled her to respond with more vigor and speed than she could on a down grade.

However defective this little goodnatured trotter was in gait and in speed she served as an object of observation and was at least in my complete control because I owned her. Since no honest man, however small his station in life, is unworthy of our respect and our good will, so this little mare, that tried to do her level best, was not unworthy of some study. The observations gathered from her trials, though not quite satisfactory, led me to work along similar lines with other horses, one of which was the other filly mentioned before.

FIG. 207



In both these cases there was an inclination for greater extension on one side or the other, which is generally an indication of the pacing gait. It was seen in Fig. 190, but in the uphill trials it disappeared more or less. The filly had acquired a low hind action with much hind forward extension because of the use of smooth shoes and also shoes slightly on the rolling motion plan, which latter seemed to give her a little better hock action, but with a forward rather than a backward extension.

Fig. 207 gives the extension of two uphill trials, one with the

shoeing of Fig. 190 and the other with a similar shoeing, but with toe-lengths varied. The second one was more satisfactory and showed less variations in the strides of the four legs. It was as clear a case of decreased variations of an uphill trial as with the other subject. In the former case such were more marked and showed the greater ease of motion uphill, and likewise with the filly now under discussion, the greater ease was also apparent to the eye when she went uphill. Reasoning from the apparent analogy, I decided to use heavy hind shoes on her and simply reversed the weights of Fig. 190, putting 6 oz. in front and 9 oz. behind. In both these cases the action of the hind legs when going uphill was the principal improvement obtained. There was a better equalization of the fore and hind action, and in general terms it may be said that the fore action decreased while the hind action increased in those uphill movements.

There is no double trial of the above change of shoes on record, but the downhill trial shows an improvement both in the extension (near fore 0.075 ft. and near hind 0.12 ft. more than opposite mate, or respectively 0.9 inch and 1.44 inch) and in the total variations. The latter were:

———Fore———		———Hind———		
Near.	Off.	Near.	Off.	Total.
3.45	3.30	3.35	3.10	(13.20)

for a stride of 14.10 ft. The hind shoes were still of the pattern with beveled toe and heels, which in itself was not a favorable condition. Another trial with unequally divided weight behind was not satisfactory, but the season was at an end.

The next year she was first tried with heel calks on hind shoes, subsequently with squared toes added and finally with more weight on top of that. This not only extended the mare, but produced a desirable and even action of the hock joint. Her strides were now over 16 ft., and her speed steadily increased. All this was the direct result of the uphill trials, and although errors are evident, they were made in good faith. It is to avoid like errors that these records are given so at length to the reader. The usual dislike for heavier hind shoes caused

me to try everything else at first, but it was due to these observations on the uphill grade that the possibility of their benefit first suggested itself.

The effects of various shoeings for the downhill grade differ in many respects materially from those of the uphill movements, but there is a happy medium that will moderate the difficulties of both ways of going. Weight in front is more prohibitive of extension than it is behind on the downhill grade, for the front legs fold in a backward manner, while weight on hind legs with their forward unfolding favors extension. Weight in front on an uphill grade, however, does not cause so much folding of knee and is apt to slightly increase front extension, while behind it has the effect of increasing the hock action and thereby somewhat lessening the hind extension.

Longer toes at either end will often cause trouble going uphill by checking the extension. In Fig. 190-B the longer front toes or longer fore legs—the heels having also been raised by the greater angle—caused much greater total variations going uphill, as in Fig. 207-A, than it did downhill, as in Fig. 190-B. They were:

	——Fore——		——Hind——		
	Near.	Off.	Near.	Off.	Totals.
Uphill	4.98	5.75	6.28	6.28	(23.29)
Downhill	3.51	2.99	3.33	4.43	(14.26)

Besides, the stride was shorter and appeared to be a little labored. This check to the front extension and the fact that the hind heels were higher (53° in A and 52° in B), and therefore the toe leverage prompter in A than in B, decreased the distance between the extremities. In the subsequent shoeing of B, with different lengths of toes, we have the total variations:

	——Fore——		——Hind——		
	Near.	Off.	Near.	Off.	Totals.
Uphill	3.94	4.20	5.17	6.44	(19.75)
Downhill	5.06	5.37	4.77	7.75	(22.95)

which is a better handling of feet going uphill, but a change for the worse downhill. The somewhat equalized lengths of toes brought

about a greater distance between the extremities. In other words, the shorter toes in front caused an easier extension uphill and a less labored motion. This condition, though not yet satisfactory even for the uphill movements, proved neither an improvement for the downhill trial. This was therefore not the happy medium looked for in the adjustment.

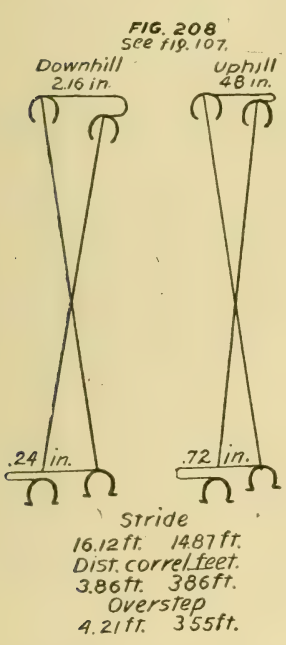
When it comes to the many combinations that can be arranged for a better balance, we shall find that but a few will equalize the manner of going in both directions. The expected change shows itself in more or less extreme form in both trials, but the purpose of these comparisons is to establish if possible a happy medium of averages, which would keep the animal going at its best both ways.

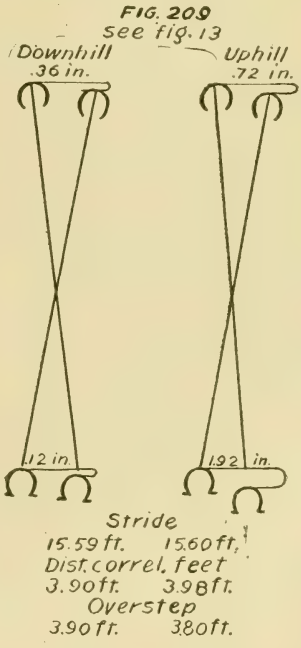
This may be further illustrated by giving the extensions in Fig. 208 of the two uphill trials of shoeing given under Figs. 106 and 107, this being, however, made without toe-weights. Fig. 106 shows the front shoes with toe-weights. For better comparison the downhill extensions appear alongside of those made uphill. We have here a decreased extension of the near fore (from 2.16 in. to 0.48 in.) and an increased extension of the off hind ((from 0.24 in. to 0.72.). In front this difference seems to be due to the higher angle (50°) of the off fore, which gives that foot an easier leverage at toe, and this readiness to extend is helped by the greater weight of shoe. The fold of the knee is not so great as it is going downhill, hence the effect of the weight (9 oz.) is toward slightly greater extension. Therefore, the near fore with its lower angle (49°) and lighter shoe (7 oz.) loses its greater extension of 2.16 in. over the off fore, and the result shows its extension to be but 0.48 in. over that of its opposite mate. Downhill that higher angle of the off fore, with its heavier shoe, had a tendency to increase the fold of knee and to put into elevation what force it put into extension going uphill. Its opposite mate, the near fore, had therefore the advantage of that checked extension of the off fore downhill and was placed ahead of the off fore.

Let me again call attention to the main point, the most palpable point in fact, in the difference between the uphill and downhill locomotion of the horse, by stating that the equalization of the action of

the extremities, as seen in the upgrade movement, is due to an increased action of the hind and somewhat decreased action of the front legs. Downhill, therefore, we are apt to have a greater knee action and a lower hock action, while uphill the reverse is generally the case.

The increased extension of the off hind in Fig. 208 is no doubt due to the difference in length of heels, as well as to the presumably greater elevation and lesser extension of the near hind. The absolute equality of the distance between fore and hind feet is noteworthy and shows





how this separation increases going uphill, for the greater stride of 16.12 ft. should have, as a rule, the greater separation as well as the greater overstep. The variations of the strides were much greater going uphill than downhill, in fact, so great that their comparison with those of the downhill movement proved that the shoeing was not quite satisfactory.

In Fig. 209 we have the extensions of the shoeing of Figs. 113 and 114. The difference in toe-lengths besides in weights is here to be considered. The shorter toe of off fore (3¼ in.) and its lower angle

(48°) and heavier shoe (11 oz.) do not offset the longer toe (3⅜ in.), higher heel (49°) and lighter shoe (9 oz.) of the near fore as far as extension goes. For, the extension of near fore increases to twice the distance (0.72 in.), although this is small in either case. It shows that the higher heel (49°) of near gives a better leverage to the longer toe than the lower heel (48°) gives to the shorter toe and heavier shoe of the off fore. Behind the shorter toe (3¼ in.) of the near and its greater weight (8 oz.) gives an easier leverage and a greater extension (1.92 in.) than the longer toe (3⅜ in.) and lighter shoe (6 oz.) of the off hind, the angles being the same.

A notable agreement in these two trials may be seen in the equality of the strides both ways (15.60 — 15.59), which gives occasion to call attention to the general rule that the separation of the extremities is greater in the uphill movement (3.98) than it is in the downhill movement (3.90), and also that the overstep in the latter (3.90) is greater than it is in the former (3.80). These differences are no doubt due to two causes, namely, the better backward extension of the hind and also, to a lesser extent, the better or easier forward extension of the fore.

In the uphill movement the fore enter more largely as drivers of the equine machine, which function is generally taken up by the hind members in both directions; but the fore do at the same time reach forward with greater vigor on account of that incline uphill. And so the general difference of effects between uphill and downhill motion may be summed up as follows:

DOWNHILL.

1. Higher action in front and lower action behind.
2. Greater and easier forward extension of hind.
3. Greater effort in forward extension of fore.
4. Naturally longer stride for a given speed.
5. Greater and easier *approach* of fore and hind.
6. Leverage at toe less dependent on a greater angle of foot.
7. Greater length of whole foot increasing extension.
8. Weight of front shoe increasing action and slightly decreasing extension.

9. Weight of hind shoe increasing extension and decreasing action.
10. Toe-weights increasing extension of fore.

UPHILL.

1. Lower action in front and higher action behind.
2. Greater and easier backward extension of hind.
3. Less effort and easier forward extension of fore.
4. Naturally shorter stride for the same speed.
5. Greater and easier *separation* of fore and hind.
6. Leverage at toe more dependent on a greater angle of foot.
7. Greater length of whole foot decreasing extension.
8. Weight of front shoe decreasing action and slightly increasing extension.
9. Weight of hind shoe decreasing extension and increasing action.
10. Toe-weights decreasing extension of fore.

In these contrasts the shape of the shoes will, of course, have a modifying influence such as has been discussed before and as may be left to the requirements of each individual horse.

While these general principles hold true for various kinds of horses, it must be admitted that the combinations regarding gait and general make-up, as found in each horse, are very varied and may therefore require special adjustments. This exposition of the gait of our harness horse, with its illustrative experiments, should, however, lead to a solution of balance in every case, provided the method by which the gait of each horse can be analyzed is employed every time. In all questions of balance it should be borne in mind that any deficiency of gait is either absolute or relative; that is to say, the absence of a desirable quality or capacity is either lacking entirely, or it is compensated by a strongly developed quality or capacity elsewhere in the total make-up of the horse. If there is no such compensation, then the harmony of motion is seriously and perhaps permanently affected, and it will be difficult to establish any sort of an equilibrium between the parts of such a disordered mechanism.

In conclusion, I wish to point out again the three conditions that each track presents in more or less varied degree, and which affect the balance of the horse. These are: the soil, the turns and the grades.

The first of these concerns the shape of the shoe, and the last two relate to the shape of the foot. Certain tracks suit some horses better than others, and such a fact may be explained by the effect which such conditions have on their deficient gait. The soil, turns and grades may all, or any one of them, prove to be compensations for such deficiencies in that horse. If not too marked, these conditions can be counteracted by a searching test of proper balance on the home track.

Leaving the condition of the soil to the good sense and judgment of the owners of tracks, and referring again to the discussion of the turns of the track in Chapter VI, I wish to lay particular stress now on the results of the downhill and uphill trials here set forth. It seemed to me very important to base many experiments and their deductions on such a slightly downhill course, because often the stretches of the tracks have such an incline, and especially so the homestretch. Here we see the supreme effort of the horse, so that all adjustment of balance should take into account such a probable event. Such a test seems to conform more truly to the actual and practical conditions met with at other places and at critical moments.

It may happen that the adjustment of shoes which worked well at home will not meet the requirements of different and strange conditions quite as readily abroad. It was with such occurrences in mind that these comparisons between uphill and downhill locomotion were made. The main object, after all, in balancing, is to be prepared for all or nearly all conditions, except those of a notoriously rough track. This preparedness for conditions differing from those that obtain at the home track is also largely a matter of education with the horse. For, the foundation of such a training should at all times be the confidence of the horse in himself, and this self-reliance—as it might almost be called—is not only fostered but also directly produced by an equalization of the action of both fore and hind such as was here set forth.

CHAPTER X.

THE MAIN FEATURES OF MEASUREMENTS.

To save time and to bring this method of measuring the tracks within the reach of all progressive trainers, its principal points are here given in as concise a manner as possible.

A square gait must be based on equal or nearly equal extensions of the four moving feet. The separation of the fore and hind legs should be based on their distance from each other when at rest. If this distance appears to be reasonable to the eye, and if the attitude of the horse at rest is fairly satisfactory, it may be taken as a basis for comparison with such average distance when at speed. Shoeing may throw this distance between the extremities, or rather between the correlated feet, out of harmony with effective motion. Pointing forward or backward, when at rest, may be increased when at speed. Muscular development may hinder the animal to get into a good swinging gait, but the wrong kind of balance is more often at fault. The "pointing" of a horse when at rest and the distance between the fore and the hind feet are therefore the principles on which are based the proper extensions of the legs. The moment, however, the animal moves fast, our eyes become deficient in judgment and we must resort to the records on the ground for any reasonable deductions.

For the sake of simplicity the lateral extensions of the feet, that is, their positions with reference to a line drawn midway between the two sulky wheel tracks, can be left to the judgment of the eye. A white cord stretched in the middle will perhaps be sufficient to indicate irregularities without going to the trouble of measuring and averaging all the distances and angles. But we cannot very well escape the labor of measuring the distances between certain feet if we desire to have any proper idea of the possible defects of a gait.

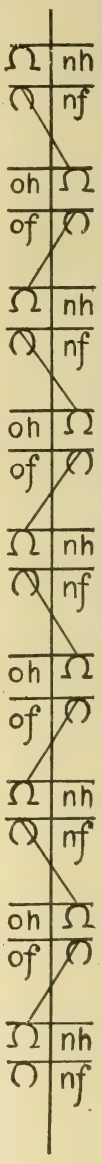
The 100-foot tape line divided into tenths and twentieths of a foot

must be used again; that is, 1/10 being = 0.10 and 1/20 = 0.05 in the decimal notation. A glance at the tracks of the feet directly after a trial

FIG. 210.

FIG. 211.

FIG. 212.



will readily show if the "overstep" in the trot, for instance, is of equal length on both sides. The fore and the hind on either side will be seen

close together in both the trot and the pace. In the trot it shows the overreaching of the hind, in the pace it shows the distance of the lateral feet as they move together. Fig. 210 gives the overstep of the trot in brackets. The distances need not be computed, but may serve as an immediate indication of unequal extensions if they appear unequal. This is easily detected by the eye, because they are close enough together to discover it at a glance as we walk along the line. If these distances, therefore, are unequal, or very much greater on one side, we suspect that either the hind foot points forward too much or that the fore points back too far; in other words, that the swing of those two legs is not the same. The shorter distance of the overstep on the opposite side would point to the other extreme, namely, that the hind leg lacked forward extension or that the fore had excessive forward extension. Let us consult the diagram showing the distances from one fore to its opposite mate and from one hind to its opposite mate (Fig. 211). The illustration presumes the regularity of extensions, but it may become more apparent from Fig. 212 (which notes the distances between the diagonal feet in the trot) that, even though the overstep may be unequal on both sides, the distance between the diagonal feet may be the same for both pairs of feet. For if, for instance, the overstep on the right side is one foot longer than on the left side or the overstep on the left side correspondingly shorter, it is still possible for the distances of the diagonal feet to be the same.

In Fig. 212 we may think of the block contained within the top and bottom cross-lines and the diagonal line connecting the correlated feet of the trot as being moved up toward the block holding the other pair of correlated feet, and thereby increase the overstep on the right side and diminish the same on the left side without changing the equality of these diagonal distances so moved. All this, however, amounts to a preliminary inspection of the tracks. The real test lies in the measurements and the averages. Taking, for instance, an actual trial where the stride was 18.1 ft. and the oversteps were found to be:

Near side : 5.24 ft.
Off side : 4.42 ft.

we have a difference of 0.82 ft. or 9.84 inches as an excess on near side.

It was caused by a greater extension of one pair of correlated feet, namely, the off fore and the near hind. The greater forward extension of the off fore over that of the near fore was 0.38 ft., or 4.56 in., and the greater forward extension of near hind over that of off hind was 0.43 ft. or 5.16 in. In spite of this difference of extensions, we find the distances between the diagonal feet nearly alike, viz.:

Near fore — off hind : 4.25 ft.
Off fore — near hind : 4.20 ft.

which makes a difference of 0.05 ft. or 0.6., a negligible quantity in the gait. This difference appears above when we take the difference between the extensions of the fore and the hind legs, which is, as above, 0.43 ft. — 0.38 ft. = 0.05 ft., or 0.6 in.; but a gait of this sort is apt to cause interference on the side of the overactive hind leg, as in this case the near hind.

The same subject gives a better example of a trot in a later trial. Here we have a stride of 18.64 ft. and a smaller distance of 3.82 ft. as the average separation between the fore and the hind feet. Once more I desire to bring before the reader the table containing the continuous measurements with the 100-ft. tape line. It presents the following figures, which are easily read off the ground and jotted down in the note book:

	Fore	Hind		Fore	Hind		Fore	Hind
n	—	5.40	n	130.65	136.50	n	261.50	267.10
o	9.40	14.95	o	140.40	146.05	o	270.85	276.55
n	18.90	24.25	n	149.60	155.10	n	280.15	285.65
o	28.20	33.60	o	158.90	164.55	o	289.25	294.75
n	37.45	42.85	n	168.30	173.75	n	298.55	304.20
o	46.75	52.30	o	177.65	183.25	o	308.10	313.30
n	56.15	61.65	n	187.00	192.55	n	317.10	322.45
o	65.45	71.10	o	196.30	202.00	o	326.35	331.90
n	74.95	80.45	n	205.45	210.75	n	336.00	340.85
o	84.25	89.95	o	214.50	220.55	o	344.90	350.30
n	93.65	99.05	n	224.65	229.65	n	354.25	359.50
o	102.80	108.55	o	233.55	239.05	o	363.50	368.95
n	112.40	117.85	n	242.75	248.25	n	372.85	378.35
o	121.50	126.80	o	252.00	257.90	o	382.20	387.60

The 100-ft. tape line was therefore stretched four times to take the desired 20 strides. From toe to toe the figures are taken down as they are found, taking care now and then to see that the feet on the ground correspond with those in the note book. To get at the length of the stride quickly we may divide the twentieth near fore measurement (372.85) by twenty, which is 18.64 ft. If we care to find the total variations from the average we will have to find the twenty strides of each leg and line them up in four columns, with the variations or differences in plus and minus from the average. The complete table is found in the investigation of Lou Dillon's gait. Here we shall not enter upon the matter.

The next step would be to find the distances from one fore to the opposite fore and from one hind to the opposite hind. This will not be difficult to find from the table of measurements, and for the four legs it reads as follows:

Fore		Hind	
off to near	near to off	off to near	near to off
9.50	9.30	9.30	9.35
9.25	9.30	9.25	9.45
9.40	9.30	9.35	9.45
9.50	9.30	9.35	9.50
9.40	9.15	9.10	9.50
9.60	9.10	9.30	8.95*
9.15	9.75*	9.70*	9.55
9.20	9.30	9.05*	9.45
9.40	9.35	9.20	9.50
9.35	9.30	9.30	9.45
9.15	9.05	8.75*	9.80*
10.15*	8.90*	9.10	9.40
9.20	9.25	9.20	9.65*
9.50	9.35	9.20	9.45
9.30	9.10	9.10	9.10
9.30	9.55	9.45	9.10
9.00*	9.25	9.15	9.45
9.65*	8.90*	8.95	9.45
9.35	9.25	9.20	9.45
9.35	9.35	9.40	9.25
20)187.70	20)185.10	20)184.40	20)188.25
9.38	9.25	9.22	9.41
+ 0.13	(Average: 9.318 ft., or 9.32 ft.)		+ 0.10

The average distance between the fore and between the hind is 9.32 ft., which is one-half of the stride, 18.64 ft. In an equal gait the sum total of the two fore extensions, as well as that of the two hind extensions, equals, or nearly equals, the length of the stride: $9.32 \times 2 = 18.64$; and even in a gait of unequal extensions the sum of both fore and both hind extensions generally equals the stride. But the average extension of each foot does not make up one-half of the stride of that particular leg in the above trial; that is to say, 9.38×2, or 18.76, is not the stride of the near fore and so on. The difference between the fore and between the hind extensions must be averaged for each pair; that is to say, the near fore in its position with reference to the off fore is $\frac{0.13}{2}$ ft. ahead of the position of the latter, or 0.065 ft. = 0.78 inch, and likewise the off hind precedes the near hind with an average distance between it and the near hind of $\frac{0.19}{2}$ ft., or 1.14 in. The stride of each leg averages the same, namely, 18.64 ft., for, if it did not, then the horse would not trot, but break into a run.

We notice, therefore, a slightly greater extension of the off hind over that of its diagonal or correlated mate, the near fore, which is 1.14 — 0.78, or 0.36 in., which will appear as the difference between the averages of the distance of the two pairs of diagonal feet.

Again taking up the table of continuous measurements, as they were put down from the actual trial, we can easily ascertain these diagonal distances by subtracting the figures of each hind leg on the right side from its mate on line diagonally below. Starting, as usual, with the first stride of near fore (18.90), we take from it the preceding measurement of the off hind (14.95) and put down in the column marked "near fore — off hind" the difference of 3.95. Proceeding to the next stride of off fore, or rather its measurement of 28.90 ft., we take from it the measurement of its preceding near hind, 24.25 ft., which gives us 3.95 again for the distance between the other pair of correlated or diagonal feet marked "off fore — near hind." Carrying this out for the twenty strides, we have the following table:

Near Fore — Off Hind		Off Fore — Near Hind
3.95	Average	3.95
3.85	3.82	3.90
3.85		3.80
3.85		3.80
3.70		3.75
3.85		3.65*
3.85		3.90
3.55*		3.80
3.75		3.90
3.75		3.75
3.45		3.75
4.10*		3.90
3.70		3.75
3.60		3.75
3.60		3.60
3.80		3.90
3.80		3.90
4.10*		4.05*
3.95		4.00
3.90		3.85
20) 75.95		20) 76.65
3.80		3.83
		+ 0.03 or 0.36 in.

The asterisks in this and the preceding table are meant to call attention to the lack or the excess of such distances, showing that they are not always the same. As before mentioned, the average of each total is the only reliable test as to any deficiencies.

From these tables we are, therefore, able to judge of the extensions of the four moving feet. The small difference in the two diagonal distances being only 0.36 in., becomes negligible in the estimate of the gait; that is to say, when the greater extensions of two correlated feet are not excessive and nearly the same (0.16 and 0.19), the gait of the horse so examined is practically a square one. If the time or labor of the calculations from the continuous measurements is confined only to the first table, namely, that of the extensions of the fore and of the hind with reference to their opposite mates, it would almost

be enough to get an idea of any existing irregularity of the gait in question. If, therefore, the trainer does nothing else but take down the straight measurements and establish the extensions illustrated by Fig. 211, he will have a quick and fairly good analysis of the gait in question; always provided that he also uses the white cord as a middle line of reference as to the various good or faulty positions of the feet, and observes the character of the impressions left on the ground. For, the nature of the concussions of the shoe with the ground may give further clews as to any impediments caused by a wrong adjustment in the shoeing.

As in the trot, so in the pace, the most important measurements or distances are those between the opposite fore and the opposite hind, and those between the lateral or correlated feet. For, the latter correspond to the diagonal pairs in the trot and should likewise be equal in distance for both sides. Figs. 213 and 214 give the positions of feet and the distances to be measured. The proceeding is the same as that in the trotting trial, with the exception that the hind feet follow instead of precede the fore feet on the ground. All resulting tables of the various measurements have, therefore, the first column marked "hind" and the second "fore," the reverse of those for the trot. Not having a good example for an illustration, I leave the matter to the reader, who will no doubt be able to figure on the same lines as given in the trot, always remembering the reversing of hind feet, which follow the fore in the pace.

In urging trainers to keep records of the various shoeings and of the trials so measured, I advocate but the prevailing methods of any business or undertaking, where reference to past events serve as instructions for improvements. Without records no work of any sort can possibly be progressive and satisfactory. We must avoid mistakes to get along better than before. All changes and results must be on record so that reference can be made to them at any time. Angles and lengths of toes should be *accurately* repeated at each shoeing, unless there is a valid reason for a change. Changes should be gradual, and time be allowed for the effect of a change. Equal angles for the fore and equal angles for the hind feet, as well as equal lengths of toes,

should form the basis from which to start an investigation of this sort; and the shape of the shoes should only then vary from the simple,

FIG. 213

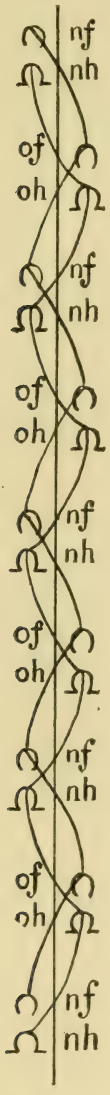
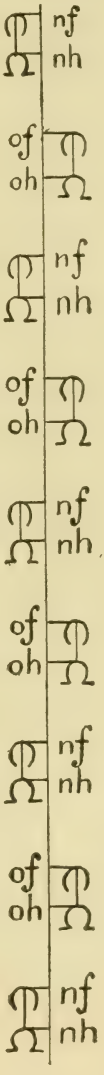


FIG. 214.



sane and safe variety when necessity seems to demand a particular shoe. The same is true of unequal weights which the gait of a horse may at times require. Vigilance at the shoeing and accuracy in the

trials when taking the few measurements and observations on the ground so gone over, should soon lead not only to a quicker understanding of the gait in question, but also to better results in balancing the horse. Even if the remedy is not readily at hand—and I do not claim to have furnished specific remedies—there remains this method of finding out the conditions of the gait; and the general principles as demonstrated will finally lead to the proper remedies for a faulty gait.

FIG. 215.

Mr. Walter Winans driving his fast trotters Captain Fullerton and Lyric, Surrenden Park, in Kent, England.

Photograph by W. A. Rouch, London.

CHAPTER XI.

A PLEA FOR A USEFUL TROTTER AND CONCLUDING REMARKS.

" * * * Wherever the trotting horse goes, he carries in his train brisk omnibuses, lively bakers' carts (and therefore hot rolls), the jolly butcher's wagon, the cheerful gig, the wholesome afternoon drive with wife and child, all the forms of moral excellence—except truth, which does not agree with any kind of horseflesh. The racer brings with him gambling, cursing, swearing, drinking, the eating of oysters, and a distaste for the mobcaps and the middle-aged virtues."

—Oliver Wendell Holmes.

Thus prophetically did charming old Dr. Holmes sound the praise, years ago, of a class of horses that our nation can really be proud of at the present time. It is well to have so broadminded a man of science, and a poet besides, make this radical distinction between the trotter and the thoroughbred running horse. Even though he calls in question the truthfulness not of the trotter himself but of the men who use him, he emphasizes his greater usefulness and sets it off against the results following from the devotion to a mere pleasure animal, *the machine in motion* used to satisfy a craving for gambling and all its attendant evils as enumerated.

Usefulness here means that a horse not only should be able to do a lot of work, but also that he should perform it with intelligence. The more intelligent a horse is, the longer will he last and the better will be his services. The great docility of the desert Arab proves that a close contact with man molds the mind and disposition of the horse. Every breeder has had similar experiences. Our nation is raising level-headed trotters because the American breeder and trainer are

level-headed. I lay great stress on the moral evolution of the American trotting stock, for without courage, without will power, without good manners, without obedience, without a high intelligence, the present prominence of the trotter could not have been attained. These essential qualities, so important in the life of a horse, are mainly the work of our American breeder. By education and by public speed contests the standard bred horse has gone through an evolution that more and more establishes a breed of horses typically American. It is but rational that horses should publicly prove their strength and endurance and, though speed is made the only test of eligibility for registration, the contests demand a showing of qualities that will insure progenitors of a robust race of horses.

Of late years the treatment of the trotter has been more or less on lines of usefulness. Barring the heaviest kind of work, we have among the representatives of the standard bred horse satisfactory material for nearly all purposes in the country as well as in the city, on the farm as well as on the track. Whether in front of the carriage, buggy, spring wagon, delivery wagon, or the implements of the field and orchard, we have had ample evidence that the American standard bred horse "fills the bill," because he has the disposition and the intelligence for such work. Some of our greatest trotters were bred by small breeders. No truer words were ever written than these: that the brood-mare, to show great results, must be *"under the hands of the breeder; he works and feeds her well. All the secret of his breeding lies in these few words."* My own experience and observation corroborate this truth. At bottom of all horse breeding stands the small farm with its one or two choice broodmares. The small breeder is the backbone of all breeding interests, and if the American trotter is to fulfill his mission of becoming a national type, appreciated everywhere for his intelligence, strength and quality, it would be well to frame his qualifications on other requirements than just speed alone. We need size and weight in the trotter if the animal is to be a useful one. He should not become a mere racing machine or a rich man's toy. In this republic of ours the trotting turf is democratic and the exhibitions of speed are "of the people, for the people, and by the people." Great

trotters and pacers, like great men, often spring from lowly surroundings, where work and frugality impart vim to the offspring, and where the unremitting care and the personal attention of the owner build up the health and energy and the confidence of the animal. As a wine-grower I would venture the comparison that great trotters are like great wines—for they can be raised and properly matured only in small lots.

The key to the whole problem of interesting *all* breeders—including the farmer who breeds most horses—in the harness contests lies in a more adequate *classification* of our standard bred horse. The mere "2:30 standard" is often unsatisfactory to practical breeders because it sets no limit to the smallness of the horse, and because it represents or encourages qualities for racing rather than for useful purposes. Every useful horse should combine size with quality, intelligence with endurance, and weight with vigor; and the development of our standard bred horse should be encouraged along such lines of utility.

It is not here intended to disparage in any manner the importance of the "2:30 standard" or the great work of the Trotting Register, which by the genius of the late John H. Wallace has given the breed of the harness horse a certain foundation and direction. There was and is great need of just such a guiding principle to develop and establish this type of a horse, and it has proved to be of inestimable value to this industry. In fact, it would be far better for harness racing and the whole development of the harness horse if only registered horses were allowed to start in races.

The Register takes the place of government supervision to some extent or of the registration of stallions as practiced on the continent. Progressive development, however, seems to call for a better criterion than a test of speed only. A standard based on speed alone is apt to disregard and even eliminate size and weight as hindrances to its end. As many harness horses show and possess these qualities it seems but fair that they should be recognized by reason of their usefulness; and an allowance for such a handicap should be made by means of a more equitable classification of the standard bred horse.

If, therefore, the trotter is to be a useful horse his development should be along broader lines, so that *all* breeders of the harness horse may have a chance to obtain full justice for their efforts in the breeding of heavier harness horses.

While for the light trotter 2:30 is a comparatively slow record, it becomes a much more difficult feat for the heavier trotter; and simple justice to all breeders demands that weight and size be made conditions of registration, so that not only the merits of the individual could be more readily recognized, but also the speed contests would present more uniformity of classes. It is to be hoped that such a plan will meet with the approval of the breeders in general, because it seems to put the breeding of the harness horse on a more systematic and sensible basis. A threefold division, therefore, into light, medium and heavy horses, such as (1), 800-1000 lbs., and up to 15½ hands tall; (2), 1000-1200 lbs., and from 15½ to 16½ hands tall, and (3), 1200-1400 lbs. and over 16½ hands tall—there being also provided three respective standards of speed for these divisions, namely, 2:15, 2:20 and 2:30, to make the individual horse eligible for registration—would not only make speed contests more interesting for the spectator, but would also grade our harness horse into proper groups for judgment and selection. As it is now, all discriminating foreigners comment unfavorably on our greatly mixed lot of standard bred horses of all sizes, looks and weights. They maintain that we have no definite type of a harness horse, and when they buy our horses it will be noticed that their selection is along lines of strength, size and quality *besides speed.*

Like the recent innovation of handicapping by distances at the start according to record or trial speed, this reasonable classification would also prove to be an advancement of the cause. It would induce many breeders to remain loyal to the standard bred horse who are apt to turn to other types for weight and size, and would enable many progressive secretaries to vary their programs and thus enhance the general interest in the speed trials.

We do not want speed alone, for that the running horse has to a far greater extent, and we know that the excitement of speed alone

brings in its wake much betting and gambling. The running horse or thoroughbred has become merely a card in a game of chance. The harness horse, on the other hand, is still admired as an individual. As long as the public interest is centered on the horse rather than on the betting, and as long as the individual horse remains an attractive object at the races, a bright future for the American harness horse is assured. It has ever been my opinion that harness racing or speed contests could and should be conducted entirely without any public betting system, because for such events should be enlisted the best element of society. Throngs of women and children will then grace the exhibitions with their delightful presence, and your strict business man will unbend and be less critical in his judgment of legitimate, clean sport. It may be argued that betting, or taking a chance on the outcome of an event, is inherent in human nature. Differences of opinions and the conceit of one's judgment are the elements that underlie this spirit of chance; but to arouse this human trait to continual action by a system of which men make a business, is to undermine all honest labor and enterprise. It is this "business" (?) of betting that has made continuous racing possible. Continuous racing is an evil like immoderate drinking, and there is no doubt that the "merry-go-round" across our Bay here was largely responsible for much crime, and especially for the numerous embezzlements occurring in this community.

The consequent prejudice against all racing hits harness contests as well. The only way to gain the favor of the general and the better public is to abolish all systems of betting. Out here in the Far West, where matters in general are still a bit "wild and woolly," gambling still holds sway, and the running horse often shares the track with the harness horse, much to the latter's detriment. Continuous racing has vitiated the people's taste for the trotter and pacer. This state has the climate and the soil to produce the best type of a standard bred horse, but distances are great between the important towns, and the population comparatively thin, and railroad transportation slow, and inadequate entirely. In consequence, meetings are few and far between—like angels' visits; and yet California has become famous for her trot-

ters and pacers. The reader will pardon me if I mention that among them is a trio bred by me: Margaret Worth 2:15, El Milagro 2:09¼, and Constancia 2:24¼, all out of my first brood mare Adeline Patti.

The point of utility, entering so largely and justly into the breeding of the trotter, should make it possible for the farmer to breed the stouter and heavier ones as types of horses fit for his own purposes and for the demands of town and city. There seems to be a gulf, however, between the tiller of the soil and the so-called harness horse man, which the latter's insistence on speed has considerably widened. Some thought should be given to size and weight in order to reconcile these two classes of men for their mutual benefit. I can not, therefore, recommend too urgently the necessity of making of the harness horse a useful one besides one that has speed. This plea is especially aimed at the trotter, because the pacer has proved to me in this hilly city—my native town—that for purposes of draft his locomotion is not as effective as that of the trotter. In fact, up and down the steep grades of these streets the pacer is at a decided disadvantage alongside of the trotter, and hence his usefulness is more limited.

The attendance and the support of the agricultural as well as the urban population rests upon the broad ground of a common interest: *the useful trotter.* Besides, the secretaries of the various associations that give meetings or exhibits might find it to their advantage to present a greater variety of speed contests and shows. The initiative, therefore, taken by Secretary Charles M. Jewett of Readville, Massachusetts, in instituting the first American Trotting Derby, is worth noting. To lay particular stress on so promising an event, the picture of the winner, Allen Winter 2:06¼, appears on the last page of this book.

The views here expressed are those of a spectator in the grandstand, with no other desire than to be amused and to get his money's worth of keen enjoyment by a varied and promptly executed program of events. There is, for instance, the annoying delay of the flying start, which ought to be modified. Repeated scoring is the bane of harness racing. A race should be promptly called as well as promptly started.

The handicapping system is likely to become popular not only because it enables the so-called outclassed horses to win a little money on the circuit of meetings, but also because it is apt to do away with the monotony of the single-file races, where certain fast horses keep at the head of the processions, thanks to the method of closing the entries very early in the season. The "glorious uncertainty" of the sport is increased by the handicap system and will not fail to draw a large and eager crowd. Even here I must plead for the recognition of size and substance in the horse as being the very features that constitute the usefulness of the harness horse; and in handicapping it might be feasible to take into consideration these admirable qualities and the accompanying capacity to pull weight, as compared with the lack of such traits in the much speedier horse.

There is, however, more to harness racing than even such a well-managed innovation as a handicap race, and that is the absolute enforcement of that set of rules by which all harness races are, or at least should be, conducted. If these rules are just and fair, and tend to protect the vital interests of harness racing, they should be *strictly enforced*. If not, then they should be abolished or amended. But in no event should such rules be ignored by any official, whatever the custom so arrogated. I have in mind a flagrant instance of arbitrary authority assumed by two secretaries. The repeal of an objectionable rule lies in a proper procedure before a meeting; but nothing so undermines harness racing, or any other sport, in the eyes of honest men, as the questionable rulings or arbitrary decisions of indifferent or partial officials, be these the judges, timers, starters, secretaries or members of the Boards of Review. Against such decrees an upright trainer or owner has but little redress, except it be the usually ineffectual process of an appeal. For, in most cases the decision of a previous inquiry will be sustained on the general principle of harmonious concurrence!

Our harness horse of to-day, with his two gaits of trotting and pacing, tends to prove that the inheritance of acquired qualities is a larger factor in the laws of heredity than men of science have been willing to admit. We have apparently better gaited and better mannered trotters and pacers to-day than we had fifty years ago. Besides,

the gaits seem to come more easily to them, and the speed, though greater, is not any more exhausting or detrimental to their vitality. This whole investigation, with its method of getting at the locomotion of the horse, is in line with the endeavor to transmit by heredity such an acquired trait as a square gait. Unless we assume it to be true that qualities acquired during the lifetime of an individual are stamped, in a greater or lesser degree, upon the offspring, all breeders would become rather despondent in their efforts. All mankind, in fact, would despair of a better state of affairs in this world years hence. Lately as eminent an investigator as Luther Burbank, our own wizard of plant life, has voiced his opinion on the heredity of acquired qualities, believing with Dr. William Darwin, son of the great scientist and originator of the theory of evolution, that such may be transmitted. It is intended, I believe, to convey the impression that such qualities will not appear as fully developed ones, but rather in the form of an aptitude, which under proper direction and training will show a more natural inclination by reason of such transmission. This latent fitness for the trot or the pace may therefore be assumed to be the result of development in both parents. The gait of the trot is even more of an acquired quality than that of the pace. We have had guideless pacers, but not yet a guideless trotter; and yet, the trotter driven with loose lines seems to indicate that such evolution, even in so short a time, has perfected the motions of the trot through successive training and by the mating of developed individuals.

In view of such intelligent and progressive development of our harness horse, one can hardly agree with the opinion of a recent writer who takes the stand that a horse, in general, is an *unreasoning coward* that should be *thoroughly deceived and intimidated* in order to make of him a tolerably safe servant of man. It was there argued that we attribute imaginary qualities to the horse, which he does not possess. The only trait that he is credited with is his home instinct. He has no courage, no faithfulness, no willingness to serve, but has only the sense of fear largely developed. We are advised to work on his fear so as to remain masters; otherwise we shall be bullied or even injured. It seems to me that such a view, if it were true, would widely en-

courage cruelty. Even in the human family, control by intimidation is too often resorted to and smothers the best traits of character. Above all, it kills self-reliance. It is so with the horse, for fear of punishment is not apt to develop courage in a horse any more than it does in man.

A physical coward may be pardoned when his stature gives him a disadvantage in a fight, but a moral coward has not even the excuse that a horse has, namely, that of being in ownership and subjection bound to one man. So why talk of fear being the only motive of the good service of a horse? In nine cases out of ten when there is anything wrong with a horse the man behind will prove not only to be the coward, but also the fool, in this combination of owner and servant. All animals should be ruled with a firm though gentle hand; but there is evidence enough among harness horses of the folly of the education by fear or intimidation. This arraignment of the horse on the score of fear and general stupidity is sadly out of harmony with the results attained from the training of our harness horse.

Had this animal been treated on the general principle of intimidation we could not to-day boast of the achievements in the development of the harness horse. While obedience may carry within it some fear, it is more largely a matter of feeding and housing, and hence a consequent habit on the part of the horse, and this habit is the more easily confirmed if the horse is treated well and without intimidation. While the character and disposition of the horse varies in the individual, as it does in the human family, the majority of the horses can be improved by gentleness rather than by cruelty. I cannot even grant the demand that the domineering habit of man should at least be allowed to spend itself on animals instead of on defenseless women and children. For, men who have this lust of power should be restrained by law in either case, and should be legally prevented from training our harness horses.

The great success of the trainers of the harness horse seems to disprove such a course of treatment. Although the difficulties confronting the trainer are many, he has time and again overcome them by his level-headedness and his patience. Sometimes he achieves fame because of his perseverance with one horse, at other times be-

cause he selects horses that suit him in temperament anl in gait; and again, but more rarely, because he is successful with all kinds of horses. We cannot always be choosers, and the last reason proves the adaptability of the man. This is a position calling for a great deal of study and investigation of the question of balancing. In such cases this book may be of some assistance. Its investigations may not always appear to be as conclusive and complete as desired, but in his work on this subject the writer was at least guided by the simple principle: *a little less mystery and a little more enlightenment.* Men are entitled to their convictions and to their business secrets which by hard work they have acquired; but it seems as if a more general progress is gained in any line of work by the more widespread knowledge of an unreserved and free investigation. Whatever may be the benefit of such an investigation and whatever view may be taken of the usefulness of the trotter, the deeper meaning of the service of this horse, as well as of *all* horses, should never be lost sight of. This great service rendered humanity is an inherent part of our much vaunted civilization, and should be judged by a broader standard than that of dollars and cents. By that service the horse is preëminently entitled to the full measure of a fair treatment. The still prevalent inhumanity of man to animals is no doubt a transmitted taint from the primeval ferocity of the human breed, which evolution has not yet blotted out by a greater sense of responsibility. Cruelty and thoughtlessness make the life of most horses a tragedy, and my plea for the trotter would be incomplete if there were not added to it this earnest appeal to my fellowmen: Be Merciful!

ALLEN WINTER 2:06½.
Winner of first American Trotting Derby. Bred by M. H. Reardon, Indianapolis, Ind.
(Photograph by courtesy of breeder.)

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